



FCC TEST REPORT

Report No: STS1809014W01

Issued for

MiMOMax Wireless Limited

540 Wairakei Road, Christchurch, 8053 New Zealand

Product Name:	800MHz Upper A Block Tornado Transceiver
Brand Name:	MiMOMax Wireless
Model Name:	MWL-TORNADO-*E A/B/C*
Series Model:	N/A
FCC ID:	XMK-MMXTRNB005
Test Standard:	FCC Part 90 Rules

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TEST RESULT CERTIFICATION

Applicant's name MiMOMax Wireless Limited
 Address 540 Wairakei Road, Christchurch, 8053 New Zealand
Manufacture's Name MiMOMax Wireless Limited
 Address 540 Wairakei Road, Christchurch, 8053 New Zealand

Product description

Product Name 800MHz Upper A Block Tornado Transceiver
 Brand Name MiMOMax Wireless
 Model Name MWL-TORNADO-*E A/B/C*
 Series Model N/A

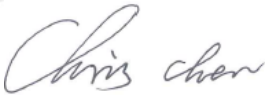
Test Standards FCC Part 90 Rules

Test procedure C63.26-2015


This device described above has been tested by STS, the test results show that the equipment under test (EUT) is in compliance with the FCC requirements. And it is applicable only to the tested sample identified in the report.

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Date of Test
 Date of performance of tests 30 Aug. 2018 ~12 Sept. 2018
 Date of Issue 14 Sept. 2018
 Test Result..... Pass

Testing Engineer : 

 (Chris chen)

Technical Manager : 

 (Sean she)

Authorized Signatory : 

 (Vita Li)





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Revision History

Rev.	Issue Date	Report NO.	Effect Page	Contents
00	12 Sept. 2018	STS1809014W01	ALL	Initial Issue





1. SUMMARY OF TEST RESULTS

Test procedures according to the technical standards:

Emission			
Standard	Item	Result	Remarks
FCC Part 90.205	Maximum Transmitter Power	PASS	
FCC Part 90.209	Occupied Bandwidth	PASS	
FCC Part 90.210	Emission Mask	PASS	
FCC Part 90.221	Adjacent channel power	PASS	
FCC Part 90.210	Transmitter Radiated Spurious Emssion	PASS	
FCC Part 90.210	Spurious Emssion on Antenna Port	PASS	
FCC Part 90.213	Frequency Stability Test	PASS	

NOTE:

(1) "N/A" denotes test is not applicable in this Test Report



1.1 TEST FACILITY

Shenzhen STS Test Services Co., Ltd.

Add.: 1/F, Building 2, Zhuoke Science Park, Chongqing Road, Fuyong, Baoan District, Shenzhen, China.

CNAS Registration No.: L7649; FCC Registration No.: 625569

IC Registration No.: 12108A; A2LA Certificate No.: 4338.01;

1.2 MEASUREMENT UNCERTAINTY

The reported uncertainty of measurement $y \pm U$ · where expended uncertainty U is based on a standard uncertainty multiplied by a coverage factor of $k=2$ · providing a level of confidence of approximately 95 % ·

No.	Item	Uncertainty
1	RF power,conducted	$\pm 0.70\text{dB}$
2	Spurious emissions,conducted	$\pm 1.19\text{dB}$
3	Spurious emissions,radiated($>1\text{G}$)	$\pm 2.83\text{dB}$
4	Spurious emissions,radiated($<1\text{G}$)	$\pm 3.01\text{dB}$
5	Temperature	$\pm 0.5^\circ\text{C}$
6	Humidity	$\pm 2\%$



2. GENERAL INFORMATION

2.1 GENERAL DESCRIPTION OF EUT

Product Name:	800MHz Upper A Block Tornado Transceiver
Brand Name:	MiMOMax Wireless
Model Name:	MWL-TORNADO-*E A/B/C*
Series Model:	N/A
Model Difference description:	N/A
Operation Frequency Range	Frequency Range: 806MHz ~ 869MHz
Maximum Transmitter Power:	24.228dBm
Channel Separation:	12.5KHz and 25.0KHz
Modulation type:	QPSK,16QAM,64QAM,256QAM
Emission Designator:	12.5KHz: 10K5W1W 25KHz: 21K2W1W
Power Rating:	Input: DC 24V/1.1A
Temperature Range:	-30°C-70°C
Test frequency list:	See Note 5
Software version number:	R04.03.04
Hardware version number:	IP001

Note:

1. For a more detailed features description, please refer to the manufacturer's specifications or the User's Manual.
2. Note: The product has the same digital working characters when operating in both two digitized voice/data mode. So only one set of test results for digital modulation modes are provided in this test report.
3. Please refer to Appendix B for the photographs of the EUT. For more details, please refer to the User's manual of the EUT.
4. Table for Filed Antenna

Ant	Brand	Model Name	Antenna Type	Connector	Gain (dBi)	NOTE
1	MiMOMax Wireless	MWL-TORNADO-*E A/B/C*	External Panel antenna, omni antenna	N/A	External Panel antenna: 10dBi,12dBi and 16dBi omni antenna:5dBi and 8dBi	Antenna

The EUT antenna is External Antenna. No antenna other than that furnished by the responsible party shall be used with the device.



5. Test frequency list

Frequency band (MHz)	Channel Separation	Test Channel	Test Frequency (MHz)
851-854	12.5kHz	CH1	851.00625
806-809		CH2	806.00625

Frequency band (MHz)	Channel Separation	Test Channel	Test Frequency (MHz)
854-869	25kHz	CH3	868.9875
809-824		CH4	823.9875
854-869		CH5	860.00
809-824		CH6	815.00

Note:

In section 15.31(m), regards to the operating frequency range over 10 MHz, the Lowest frequency, the middle frequency, and the highest frequency of channel were selected to perform the test, please see the above listed frequency for testing.



2.2 EUT OPERATION MODE

The EUT has been tested under typical operating condition and The Transmitter was operated in the normal operating mode. The TX frequency was fixed which was for the purpose of the measurements..

2.3 DESCRIPTION OF TEST MODES

To investigate the maximum EMI emission characteristics generates from EUT, the test system was pre-scanning tested base on the consideration of following EUT operation mode or test configuration mode which possible have effect on EMI emission level. Each of these EUT operation mode(s) or test configuration mode(s) mentioned above was evaluated respectively.

Final Test Mode	Modulation	Channel Separation	Frenquency
Model 1	QPSK	12.5kHz	851.00625
Model 2	QPSK		806.00625
Model 3	16QAM		851.00625
Model 4	16QAM		806.00625
Model 5	64QAM		851.00625
Model 6	64QAM		806.00625
Model 7	256QAM		851.00625
Model 8	256QAM		806.00625
Model 9	QPSK	25kHz	868.9875
Model 10	QPSK		823.9875
Model 11	QPSK		860.00
Model 12	QPSK		815.00
Model 13	16QAM		868.9875
Model 14	16QAM		823.9875
Model 15	16QAM		860.00
Model 16	16QAM		815.00
Model 17	64QAM		868.9875
Model 18	64QAM		823.9875
Model 19	64QAM		860.00
Model 20	64QAM		815.00
Model 21	256QAM		868.9875
Model 22	256QAM		823.9875
Model 23	256QAM		860.00
Model 24	256QAM		815.00



Model 1:

The equipment is set with QPSK modulation and 12.5KHz bandwidth for transmitter, powered by DC 24V.

Model 2:

The equipment is set with QPSK modulation and 12.5KHz bandwidth for transmitter, powered by DC 24V.

Model 3:

The equipment is set with 16QAM modulation and 12.5KHz bandwidth for transmitter, powered by DC 24V.

Model 4:

The equipment is set with 16QAM modulation and 12.5KHz bandwidth for transmitter, powered by DC 24V.

Model 5:

The equipment is set with 64QAM modulation and 12.5KHz bandwidth for transmitter, powered by DC 24V.

Model 6:

The equipment is set with 64QAM modulation and 12.5KHz bandwidth for transmitter, powered by DC 24V.

Model 7:

The equipment is set with 256QAM modulation and 12.5KHz bandwidth for transmitter, powered by DC 24V.

Model 8:

The equipment is set with 256QAM modulation and 12.5KHz bandwidth for transmitter, powered by DC 24V.

Model 9:

The equipment is set with QPSK modulation and 25.0KHz bandwidth for transmitter, powered by DC 24V.

Model 10:

The equipment is set with QPSK modulation and 25.0KHz bandwidth for transmitter, powered by DC 24V.

Model 11:

The equipment is set with QPSK modulation and 25.0KHz bandwidth for transmitter, powered by DC 24V.

Model 12:

The equipment is set with QPSK modulation and 25.0KHz bandwidth for transmitter, powered by DC 24V.

Model 13:

The equipment is set with 16QAM modulation and 25.0KHz bandwidth for transmitter, powered by DC 24V.

Model 14:

The equipment is set with 16QAM modulation and 25.0KHz bandwidth for transmitter, powered by DC 24V.

Model 15:

The equipment is set with 16QAM modulation and 25.0KHz bandwidth for transmitter, powered by DC 24V.

Model 16:

The equipment is set with 16QAM modulation and 25.0KHz bandwidth for transmitter, powered by DC 24V.

Model 17:

The equipment is set with 64QAM modulation and 25.0KHz bandwidth for transmitter, powered by DC 24V.

Model 18:

The equipment is set with 64QAM modulation and 25.0KHz bandwidth for transmitter, powered by DC 24V.

Model 19:

The equipment is set with 64QAM modulation and 25.0KHz bandwidth for transmitter, powered by DC 24V.



Model 20:

The equipment is set with 64QAM modulation and 25.0KHz bandwidth for transmitter, powered by DC 24V.

Model 21:

The equipment is set with 256QAM modulation and 25.0KHz bandwidth for transmitter, powered by DC 24V.

Model 22:

The equipment is set with 256QAM modulation and 25.0KHz bandwidth for transmitter, powered by DC 24V.

Model 23:

The equipment is set with 256QAM modulation and 25.0KHz bandwidth for transmitter, powered by DC 24V.

Model 24:

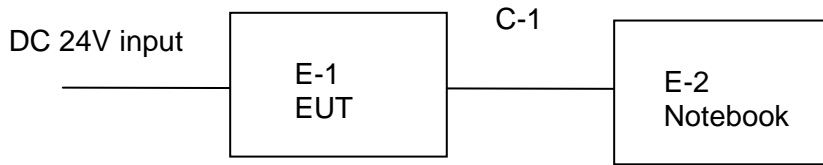
The equipment is set with 256QAM modulation and 25.0KHz bandwidth for transmitter, powered by DC 24V.

Note:

(1) Due to the different configuration and test, in this list only some worse mode. The worst test data of the worse mode is reported by this report.



2.4 BLOCK DIGRAM SHOWING THE CONFIGURATION OF SYSTEM TESTED



2.5 DESCRIPTION OF SUPPORT UNITS

The EUT has been tested as an independent unit together with other necessary accessories or support units. The following support units or accessories were used to form a representative test configuration during the tests.

Item	Equipment	Mfr/Brand	Model/Type No.	Series No.	Note
E-2	Notebook	HP	500-320cx	N/A	N/A

Item	Shielded Type	Ferrite Core	Length	Note
C-1	Network line	N/A	120cm	N/A

Note:

- (1) The support equipment was authorized by Declaration of Confirmation.
- (2) For detachable type I/O cable should be specified the length in cm in 『Length』 column.
- (3) “YES” is means “shielded” “with core”; “NO” is means “unshielded” “without core”.

2.6 EQUIPMENTS LIST FOR ALL TEST ITEMS

The EUT has been tested as an independent unit together with other necessary accessories or support units. The following support units or accessories were used to form a representative test configuration during the tests.



2.7 TEST EQUIPMENT

Kind of Equipment	Manufacturer	Type No.	Serial No.	Last calibration	Calibrated until
Signal Analyzer	Agilent	N9020A	MY49100060	2017.10.15	2018.10.14
Signal Generator	Agilent	N5182A	MY46240556	2017.10.15	2018.10.14
Audio Generator	TRONSON	TAG-101	20030212	2017.10.15	2018.10.14
Bilog Antenna	TESEQ	CBL6111D	34678	2017.11.02	2018.11.01
Horn Antenna	Schwarzbeck	BBHA 9120D	9120D-1343	2017.10.27	2018.10.26
50Ω Coaxial Switch	Anritsu	MP59B	6200264416	2017.10.15	2018.10.14
Pre-mpifier (0.1M-3GHz)	EM	EM330	60538	2018.03.11	2019.03.10
PreAmplifier (1G-26.5GHz)	Agilent	8449B	60538	2017.10.15	2018.10.14
Attenuator	HP	8494B	DC-18G	2017.10.15	2018.10.14
programmable power supply	Agilent	3642A	STS-S095	N.C.R	N.C.R
AC Power Source	APC	KDF-11010G	F214050035	N.C.R	N.C.R
Audio analyzer	R&S	UPL	100689	2018.03.08	2019.03.07
RF COMMUNICATION TEST SET	HP	N8920A	348A05658	2017.10.15	2018.10.14

3. MAXIMUM TRANSMITTER POWER

3.1 LIMITS

Per FCC Part 2.1046 and Part 90.205: Maximum ERP is dependent upon the station's antenna HAAT and required service area.

The output power shall not exceed by more than 20 percent either the output power shown in the Radio Equipment List [available in accordance with §90.203(a)(1)] for transmitters included in this list or when not so listed, the manufacturer's rated output power for the particular transmitter specifically listed on the authorization.

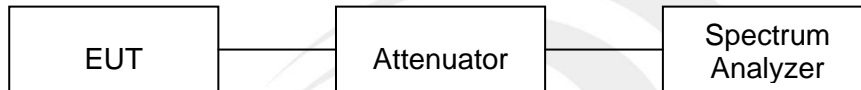
3.2 TEST PROCEDURE

Measurements shall be made to establish the radio frequency power delivered by the transmitter the standard output termination. The power output shall be monitored and recorded and no adjustment shall be made to the transmitter after the test has begun, except as noted below: If the power output is adjustable, measurements shall be made for the highest and lowest power levels. The EUT connect to the Spectrum Analyzer through 30 dB attenuator.

3.3 DEVIATION FROM TEST STANDARD

No deviation

3.4 TEST SETUP BLOCK DIAGRAM



3.5 TEST RESULT

Modulation Type	Channel Sparation	Test Channel	Test Frequency (MHz)	Test Results (dBm)	Test Results (W)
Un-modulation	12.5KHz	CH1	851.00625	23.971	0.250
		CH2	806.00625	23.949	0.248
Un-modulation	25KHz	CH3	868.9875	24.228	0.265
		CH4	823.9875	24.011	0.252
Un-modulation	25KHz	CH5	860	24.071	0.255
		CH6	815	23.920	0.247

Note: The rated power is 0.25W, the power limits is 0.2W~0.3W.

4. OCCUPIED BANDWIDTH

4.1 LIMIT

Occupied Bandwidth: The EUT was connected to the spectrum analyzer via the main RF connector, and through an appropriate attenuator. The EUT was controlled to transmit its maximum power. Then the bandwidth of 99% power can be measured by the spectrum analyzer. The maximum authorized bandwidth shall not be more than that normally authorized for digital data mode.

4.2 MEASUREMENT PROCEDURE

- a. The EUT was connected to the spectrum analyzer through sufficient attenuation.
- b. Set EUT as digital data mode.
- c. Set SPA Center Frequency=fundamental frequency, RBW=300Hz, VBW=3KHz, span =15KHz or 30KHz.
- e Set SPA Max hold. Mark peak, Set 99% Occupied Bandwidth.

4.3 TEST SETUP BLOCK DIAGRAM



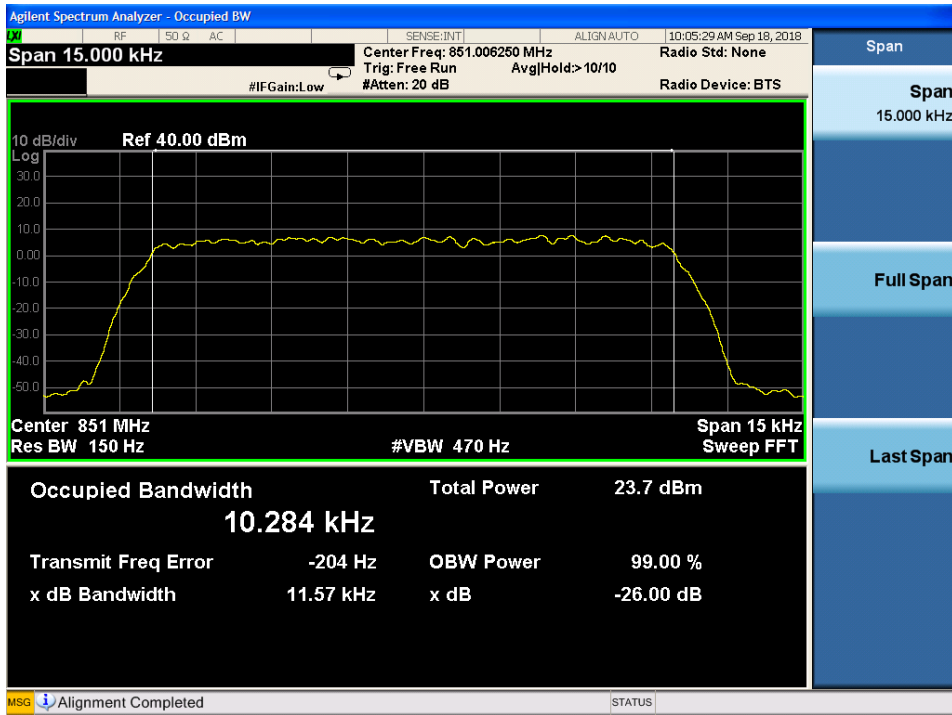
4.4 TEST RESULT

Modulation Type	Channel Sparation	Operation Mode	Test Channel	Test Frequency (MHz)	Occupied Bandwidth (KHz)
					99%
QPSK	12.5KHz	Mode 1	CH1	851.00625	10.284
		Mode 2	CH2	806.00625	10.295
16QAM	12.5KHz	Mode 3	CH1	851.00625	10.298
		Mode 4	CH2	806.00625	10.367
64QAM	12.5KHz	Mode 5	CH1	851.00625	10.298
		Mode 6	CH2	806.00625	10.303
256QAM	12.5KHz	Mode 7	CH1	851.00625	10.302
		Mode 8	CH2	806.00625	10.203



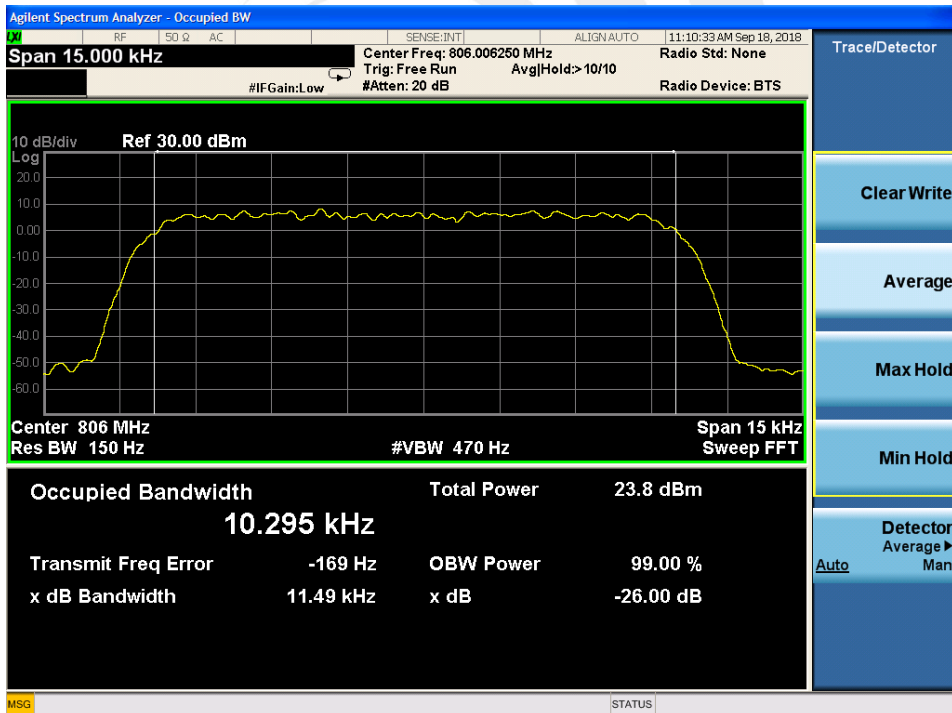
CH 1

Model 1



CH 2

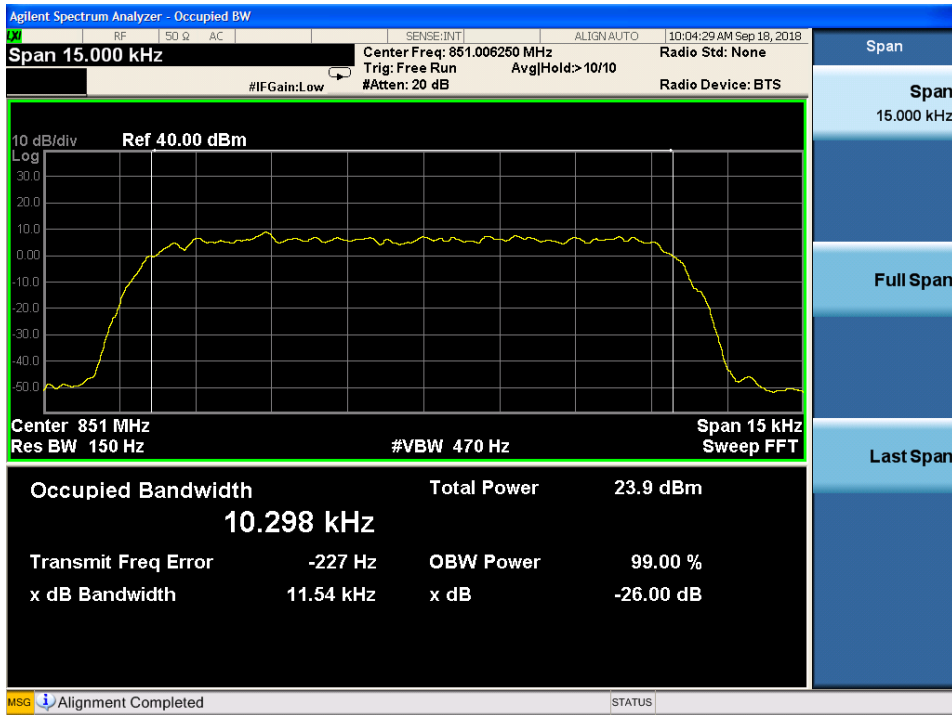
Model 2





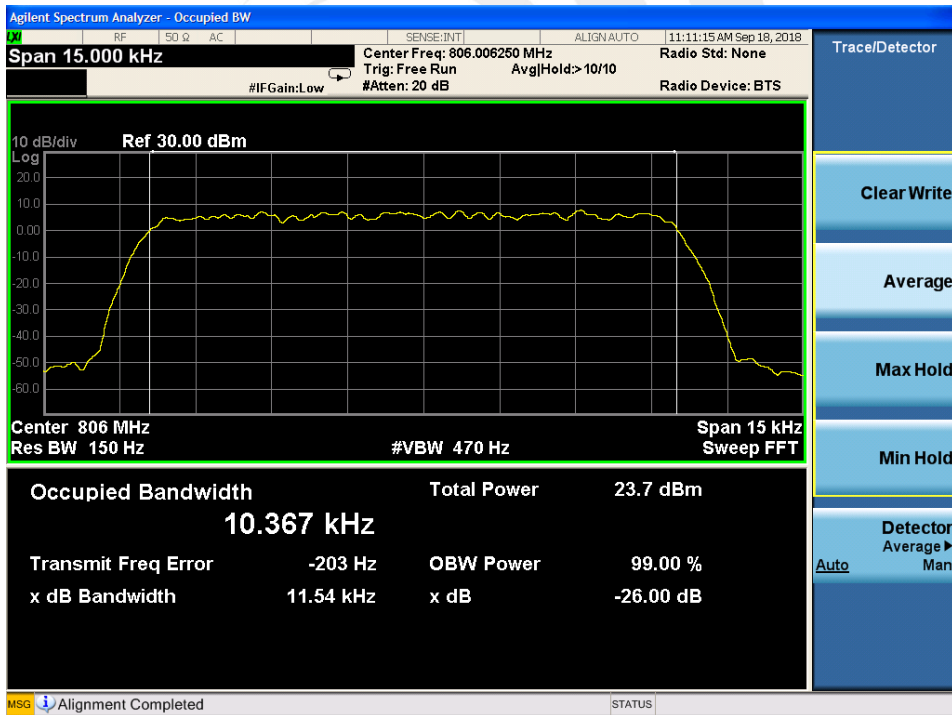
CH 1

Model 3



CH 2

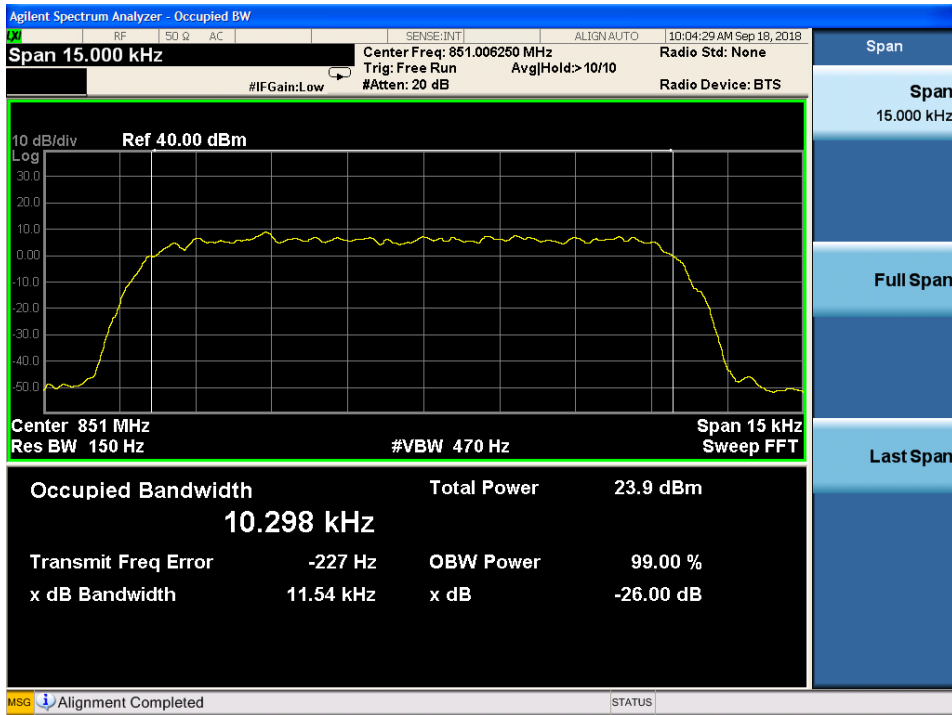
Model 4





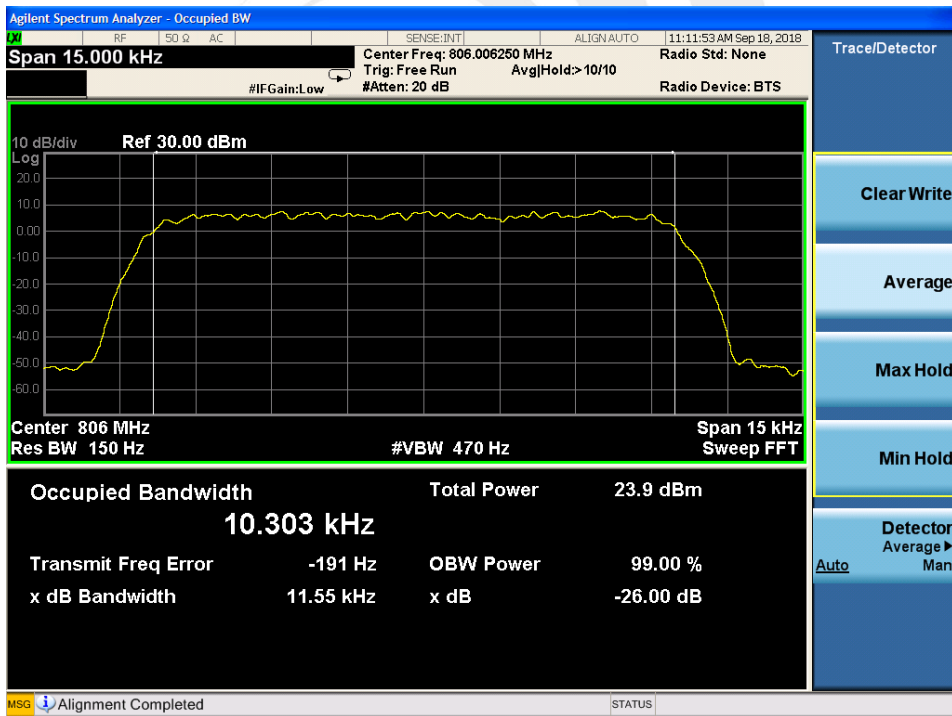
CH 1

Model 5



CH 2

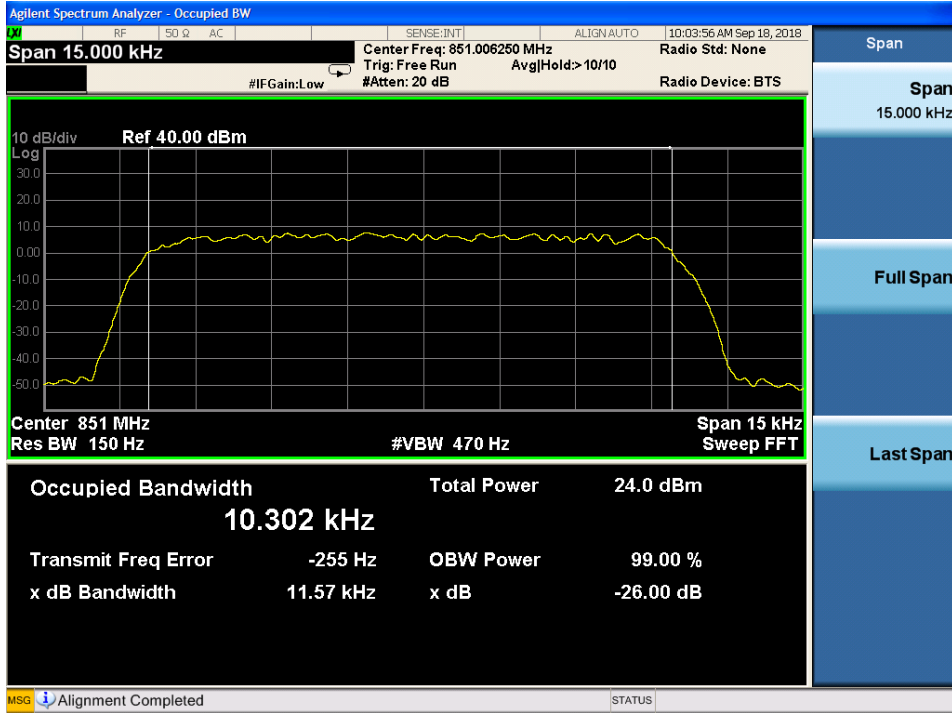
Model 6





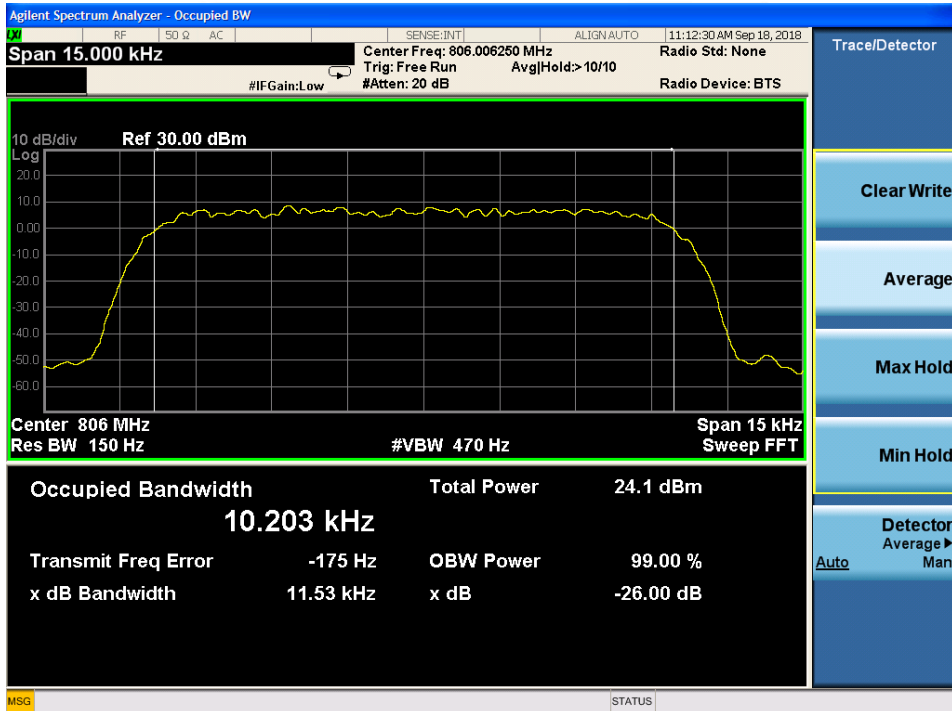
CH 1

Model 7



CH 2

Model 8



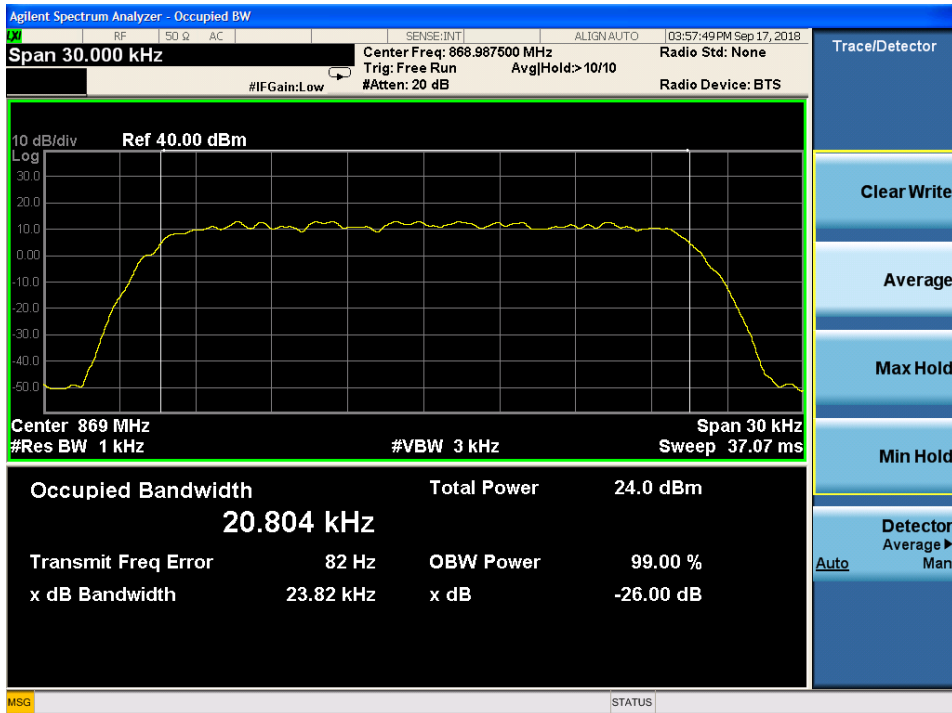


Modulation Type	Channel Sparation	Operation Mode	Test Channel	Test Frequency (MHz)	Occupied Bandwidth (KHz)
					99%
QPSK	25.0KHz	Mode 9	CH3	868.9875	20.804
		Mode 10	CH4	823.9875	20.759
		Mode 11	CH5	860.00	20.892
		Mode 12	CH6	815.00	20.859
16QAM	25.0KHz	Mode 13	CH3	868.9875	20.804
		Mode 14	CH4	823.9875	20.863
		Mode 15	CH5	860.00	20.852
		Mode 16	CH6	815.00	20.884
64QAM	25.0KHz	Mode 17	CH3	868.9875	20.849
		Mode 18	CH4	823.9875	20.767
		Mode 19	CH5	860.00	20.904
		Mode 20	CH6	815.00	20.957
256QAM	25.0KHz	Mode 21	CH3	868.9875	20.833
		Mode 22	CH4	823.9875	20.997
		Mode 23	CH5	860.00	21.025
		Mode 24	CH6	815.00	20.902



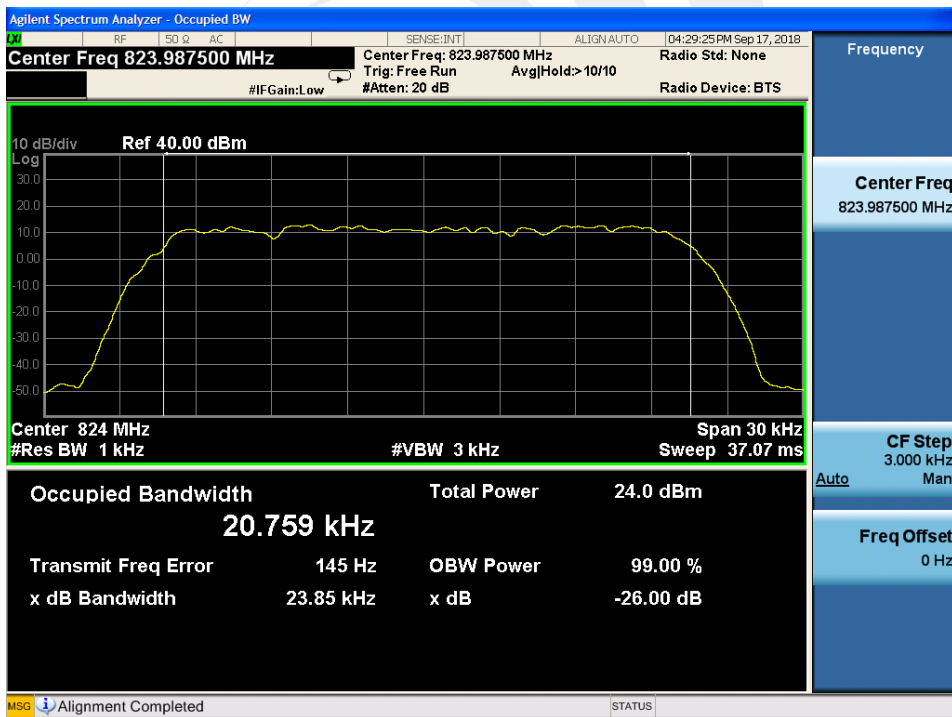
CH 3

Model 9



CH 4

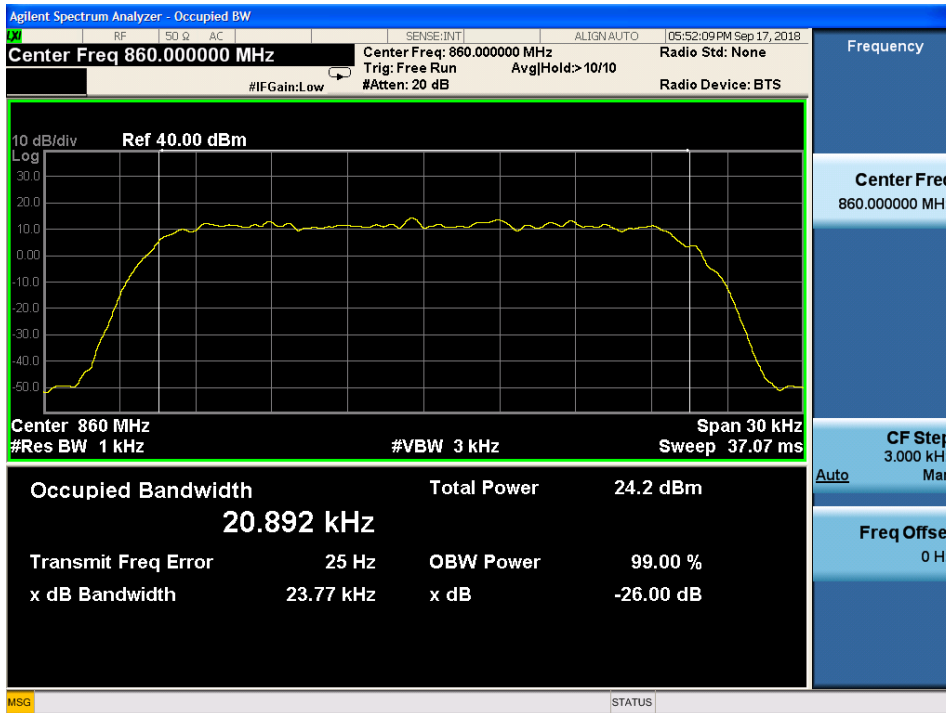
Model 10





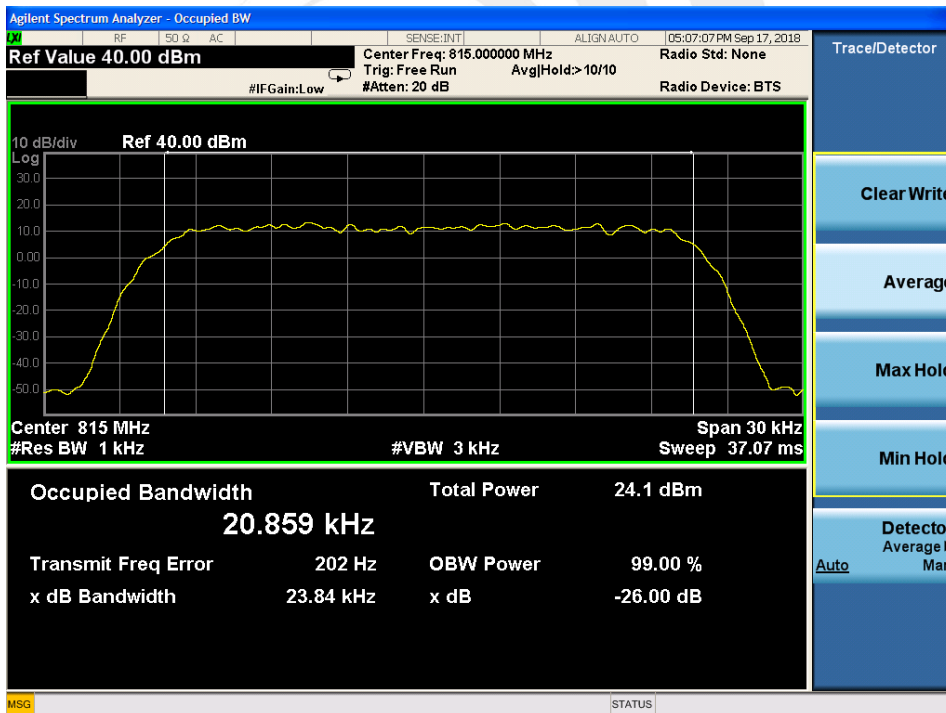
CH 5

Model 11



CH 6

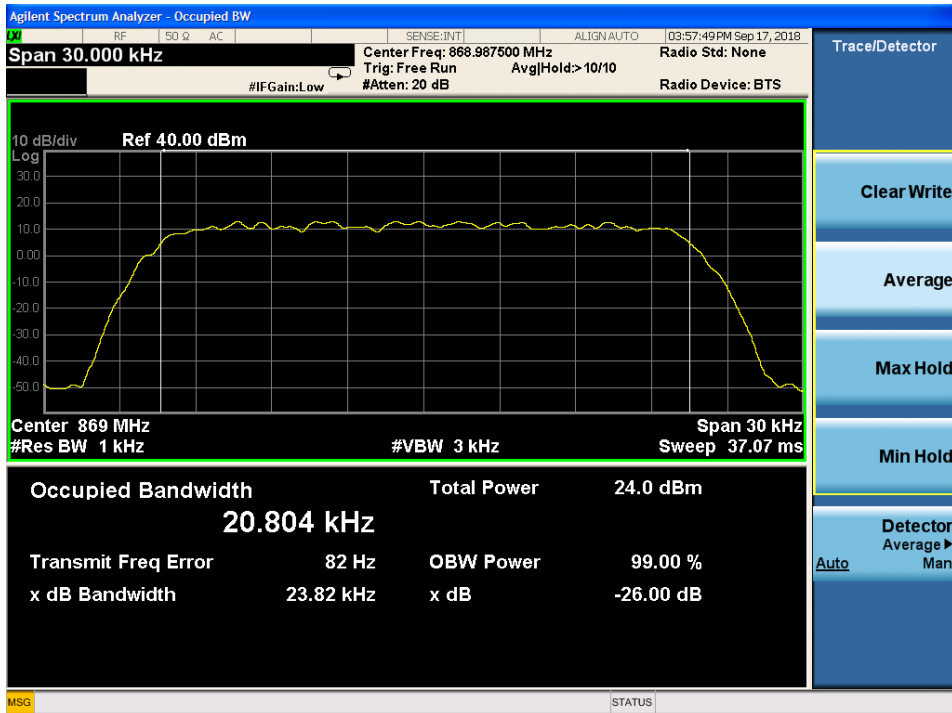
Model 12





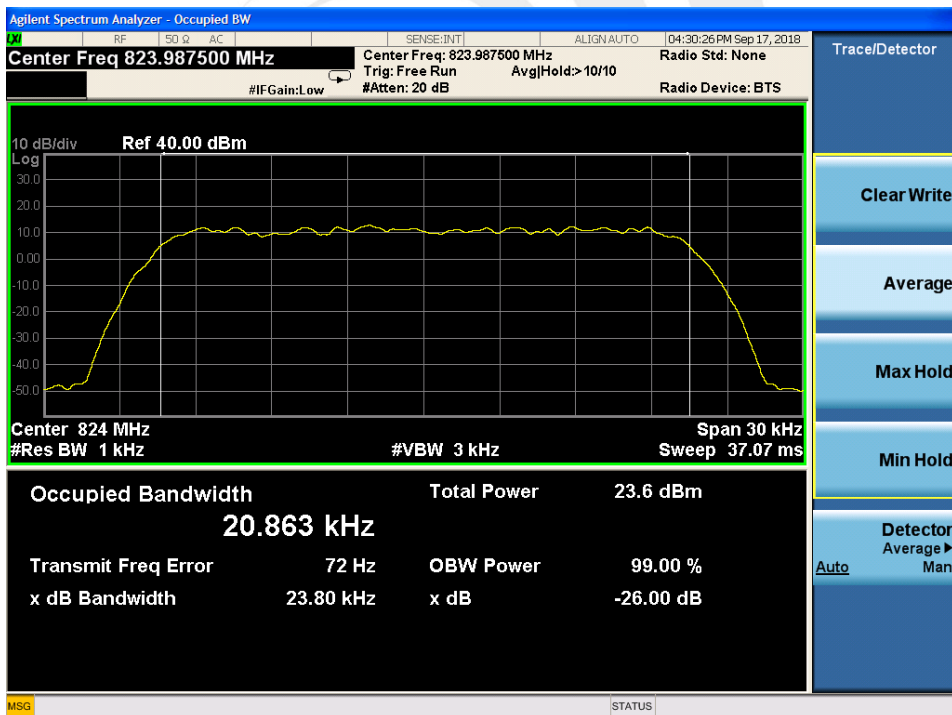
CH 3

Model 13



CH 4

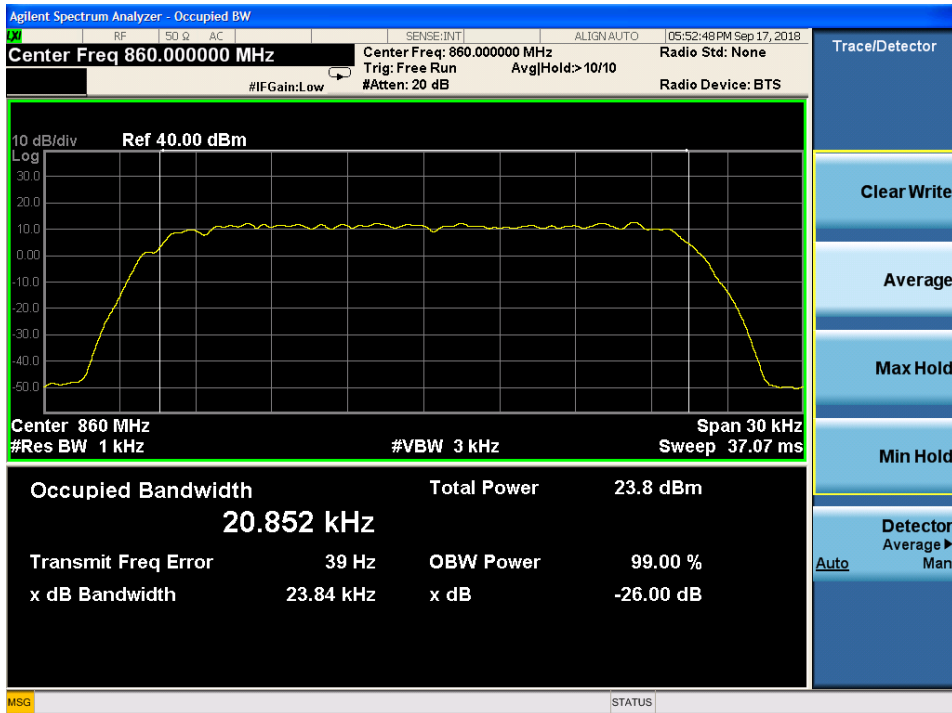
Model 14





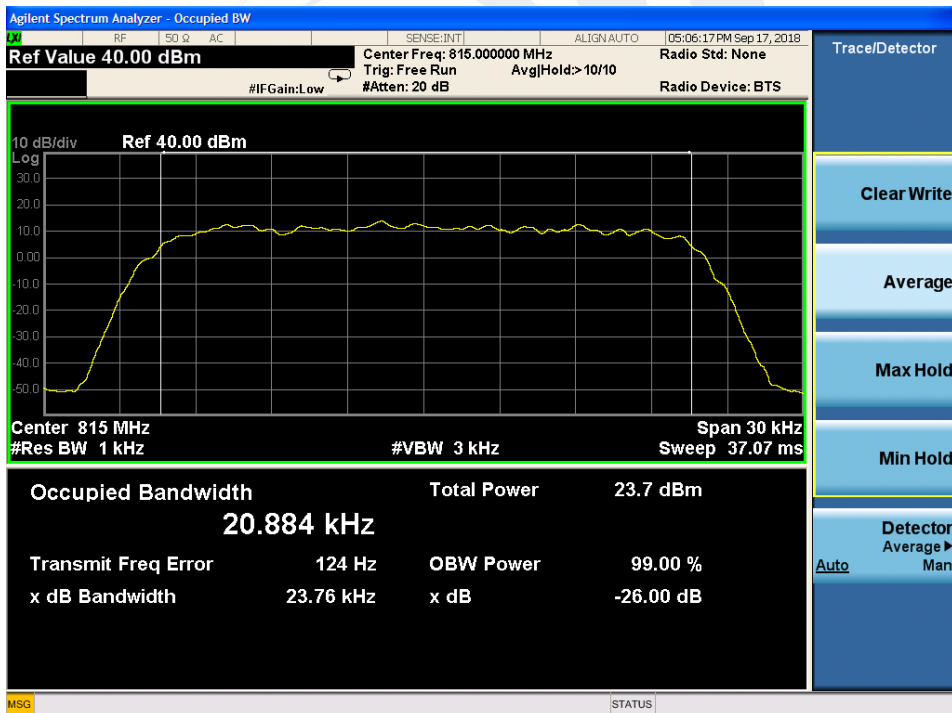
CH 5

Model 15



CH 6

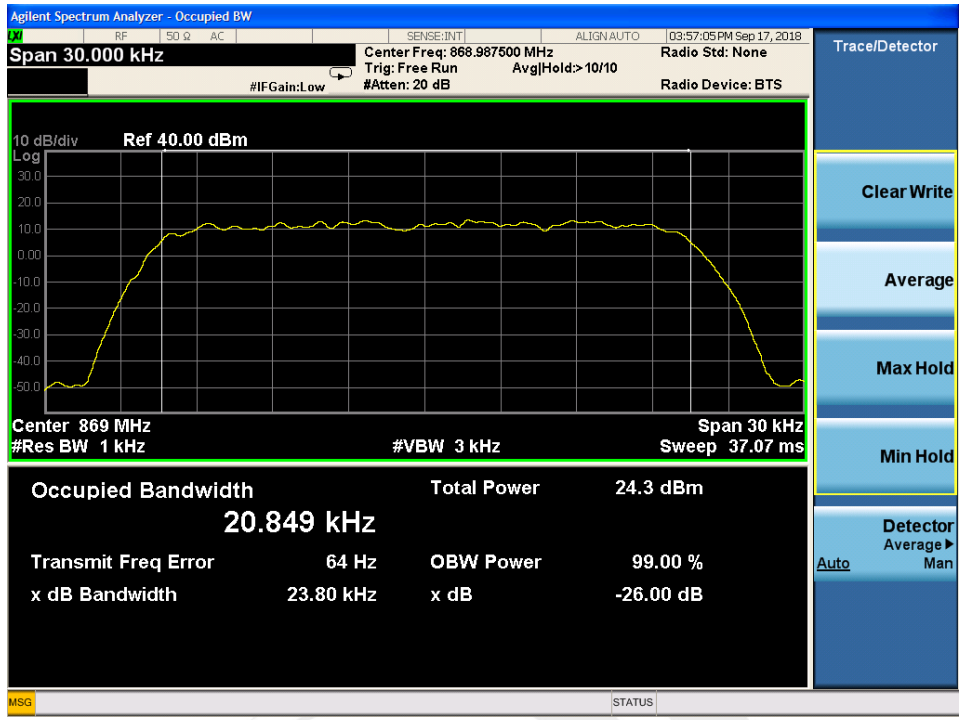
Model 16





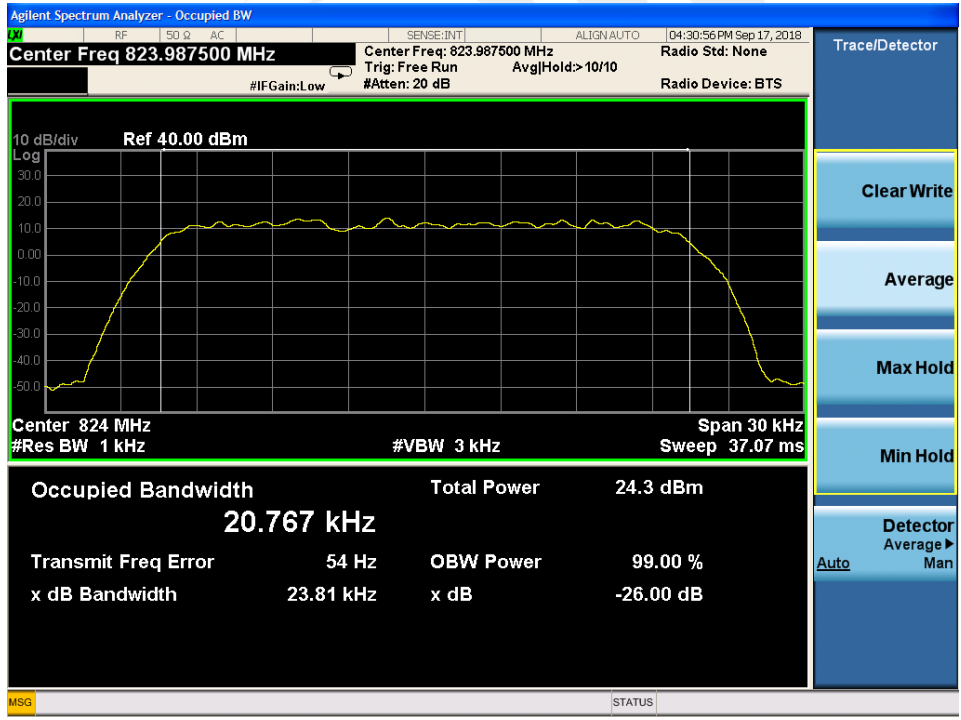
CH 3

Model 17



CH 4

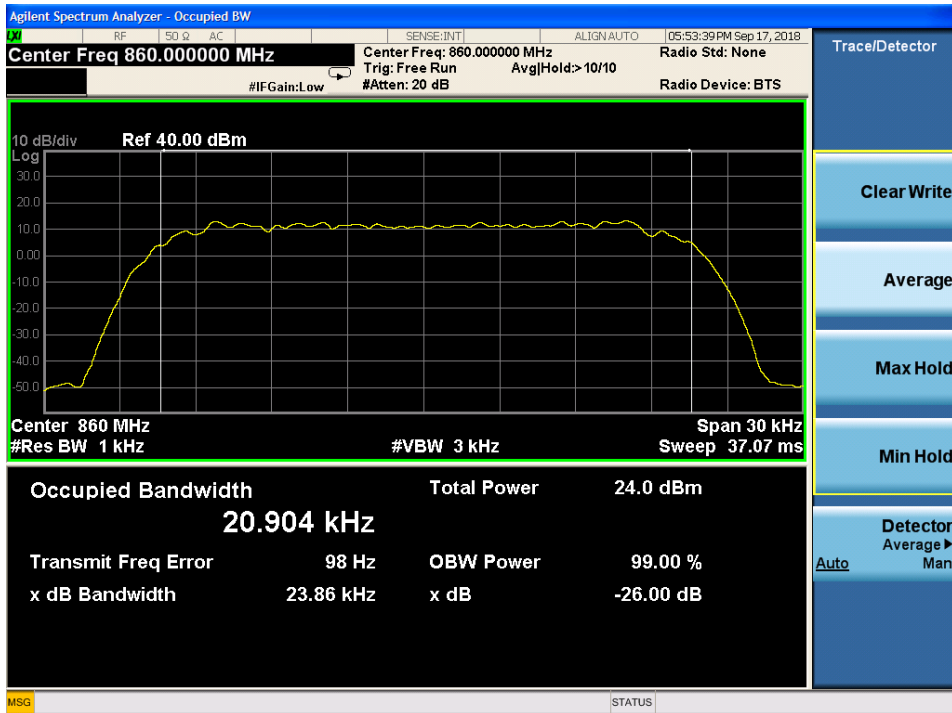
Model 18





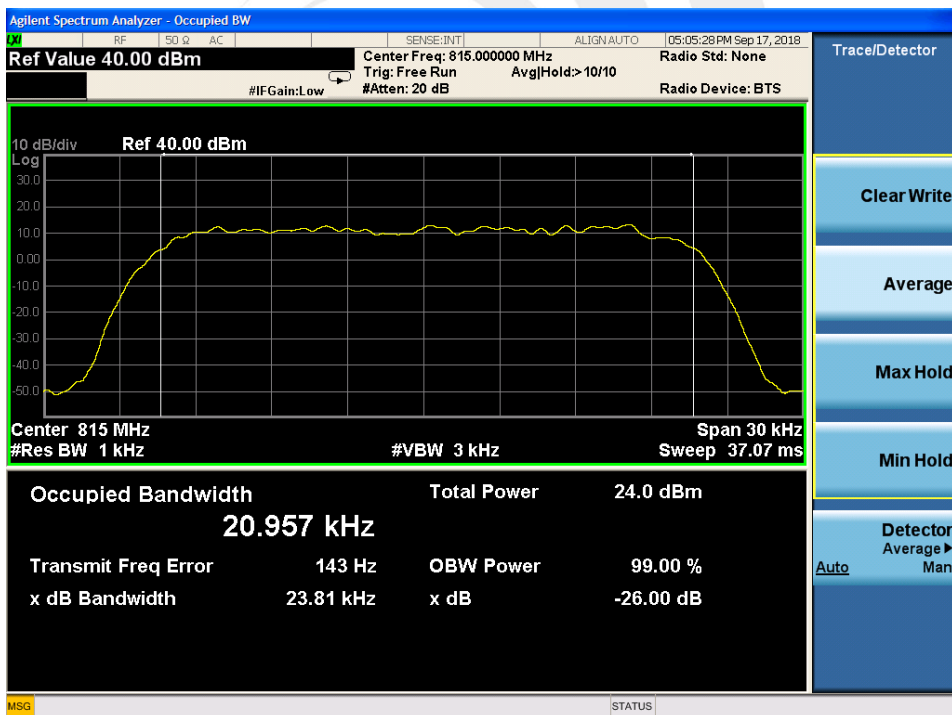
CH 5

Model 19



CH 6

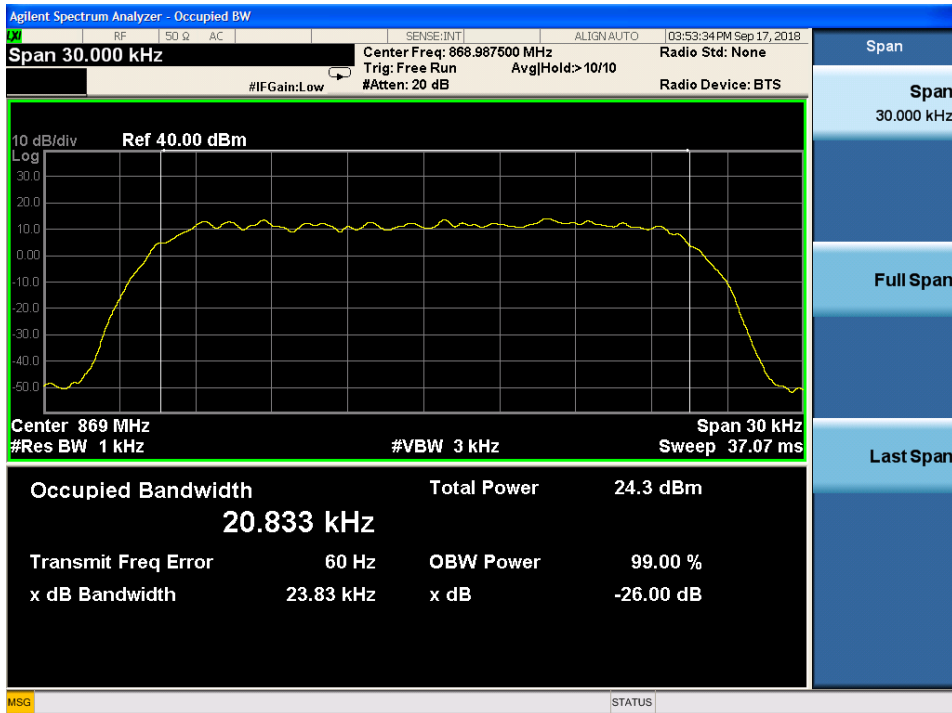
Model 20





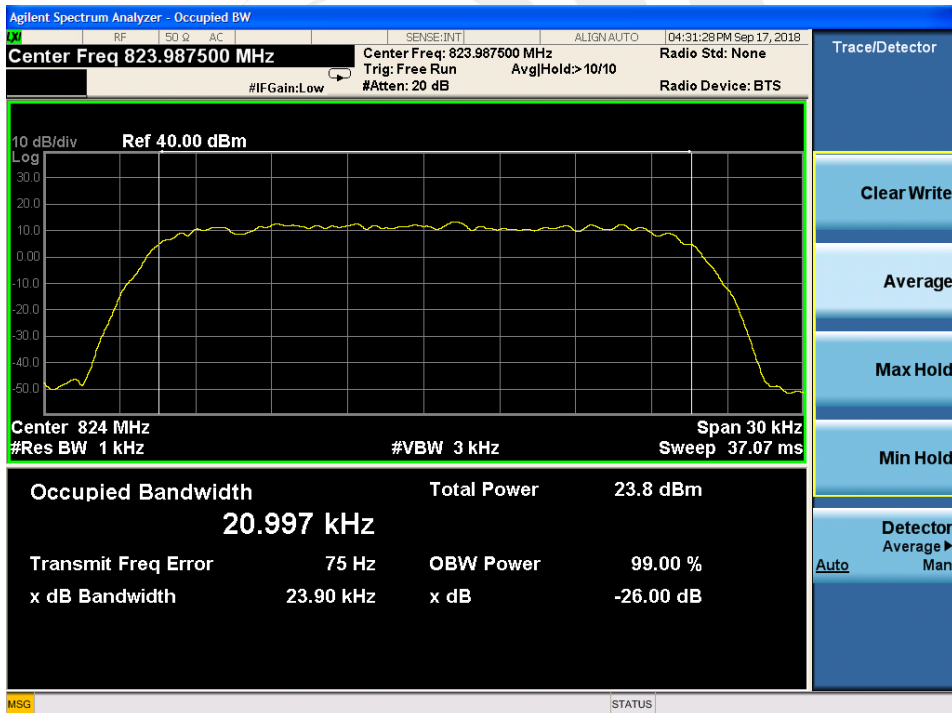
CH 3

Model 21



CH 4

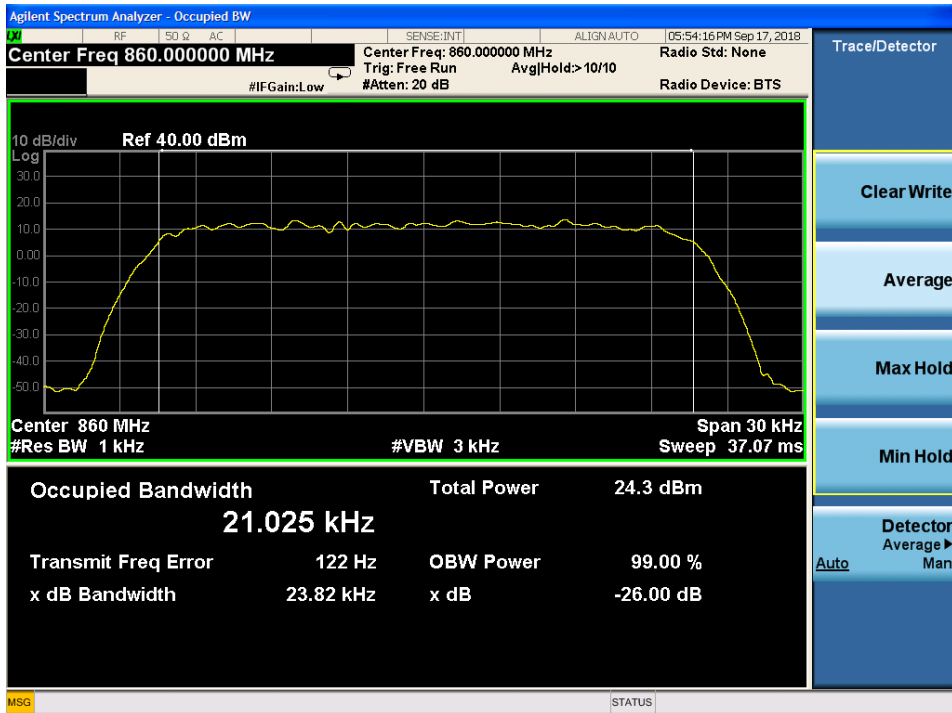
Model 22





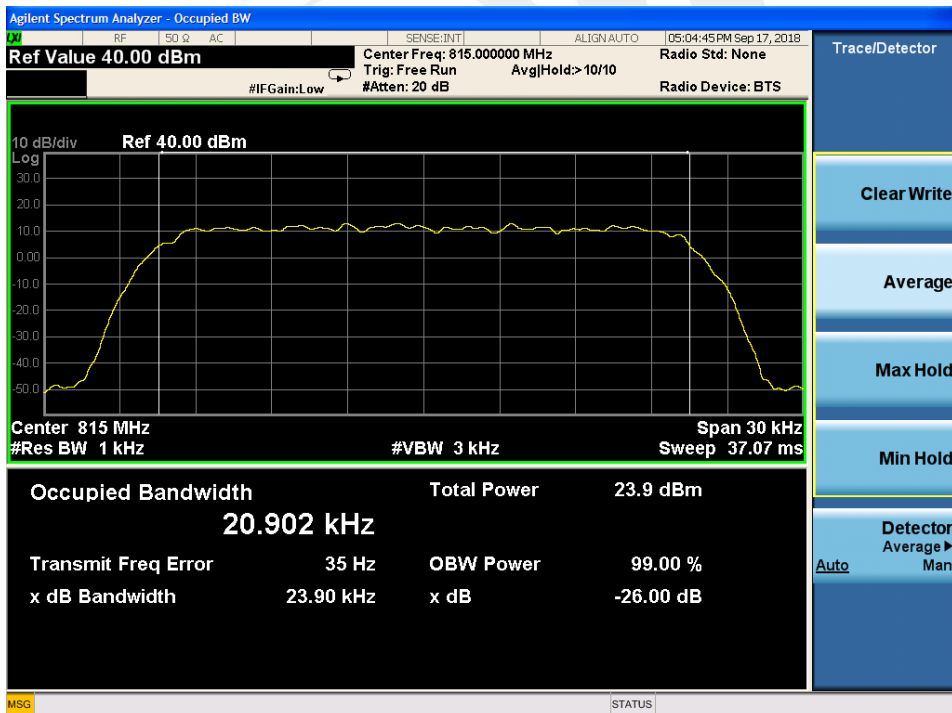
CH 5

Model 23



CH 6

Model 24



5. EMISSION MASK

5.1 PROVISIONS APPLICABLE

- (h) Emission Mask H. For transmitters that are not equipped with an audio low-pass filter, the power of any emission must be attenuated below the unmodulated carrier power (P) as follows:
- (1) On any frequency removed from the center of the authorized bandwidth by a displacement frequency (f_d in kHz) of 4 kHz or less: Zero dB.
 - (2) On any frequency removed from the center of the authorized bandwidth by a displacement frequency (f_d in kHz) of more than 4 kHz, but no more than 8.5 kHz: At least $107 \log (f_d/4)$ dB;
 - (3) On any frequency removed from the center of the authorized bandwidth by a displacement frequency (f_d in kHz) of more than 8.5 kHz, but no more than 15 kHz: At least $40.5 \log (f_d/1.16)$ dB;
 - (4) On any frequency removed from the center of the authorized bandwidth by a displacement frequency (f_d in kHz) of more than 15 kHz, but no more than 25 kHz: At least $116 \log (f_d/6.1)$ dB;
 - (5) On any frequency removed from the center of the authorized bandwidth by more than 25 kHz: At least $43 + 10 \log (P)$ dB.

5.2 MEASUREMENT PROCEDURE

- a. The EUT was connected to the spectrum analyzer through sufficient attenuation.
- b. Set EUT as digital data mode.
- c. Set SPA Center Frequency=fundamental frequency, RBW=1kHz, VBW=3KHz, span =100KHz.

5.3 TEST SETUP BLOCK DIAGRAM

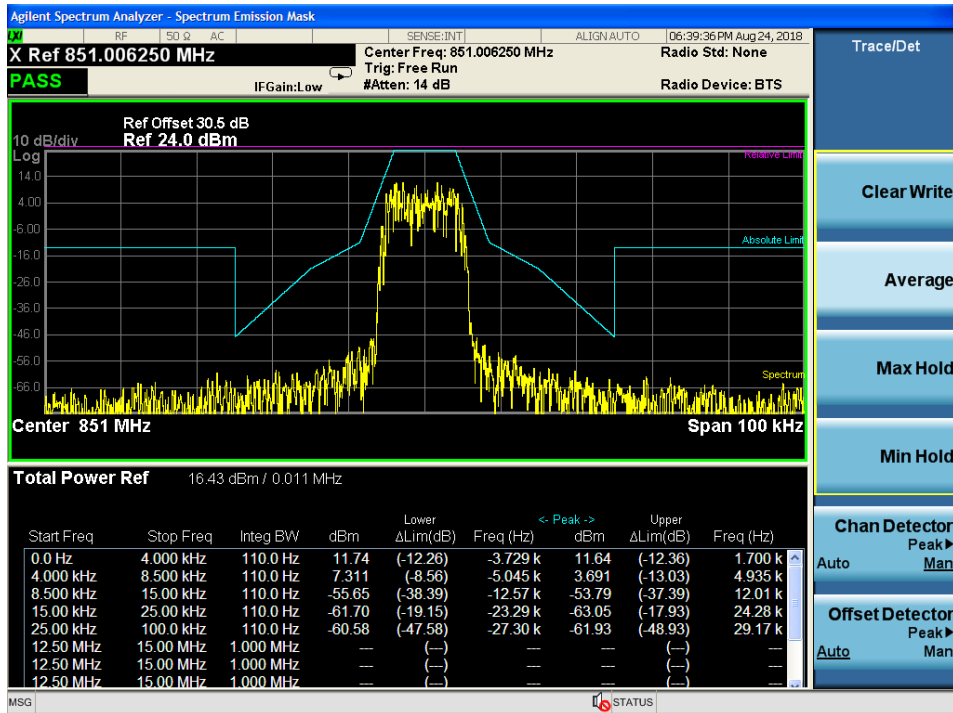




5.4 MEASUREMENT RESULT

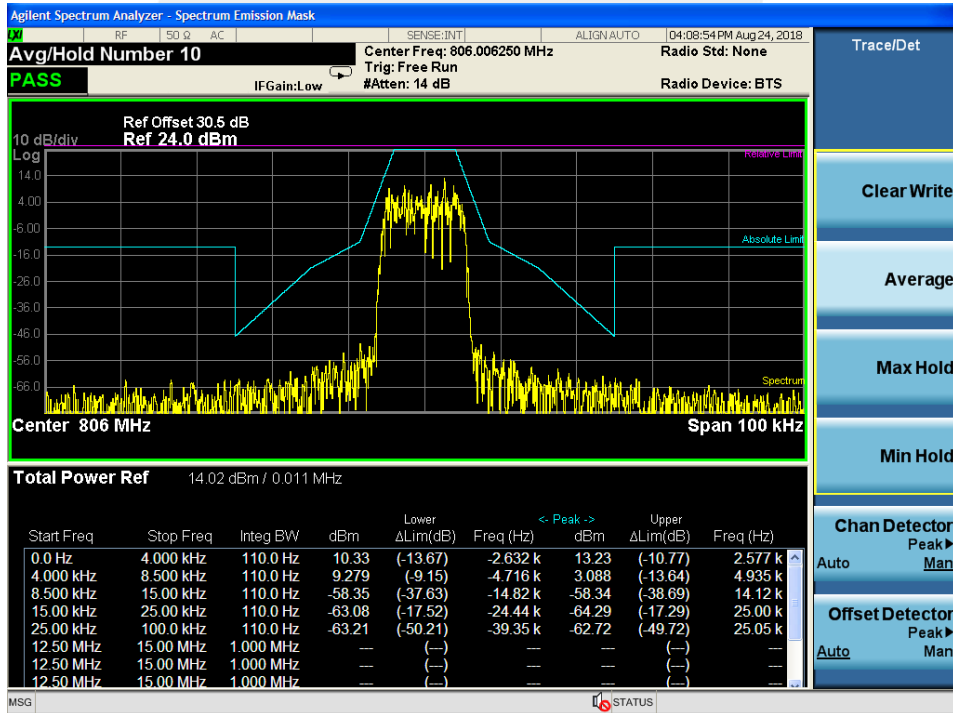
CH 1

Model 1



CH 2

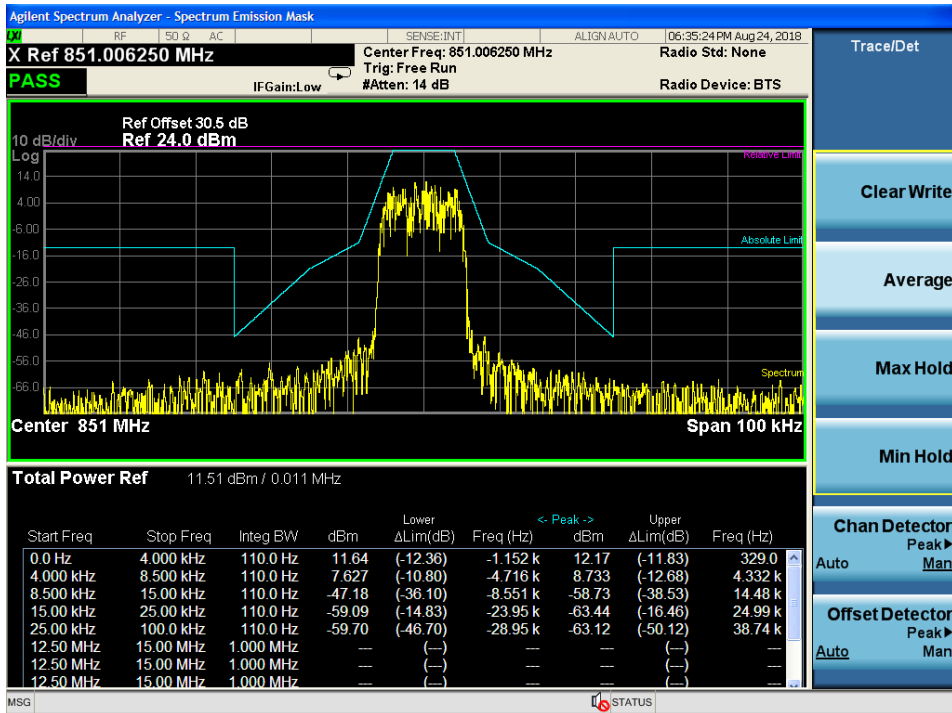
Model 2





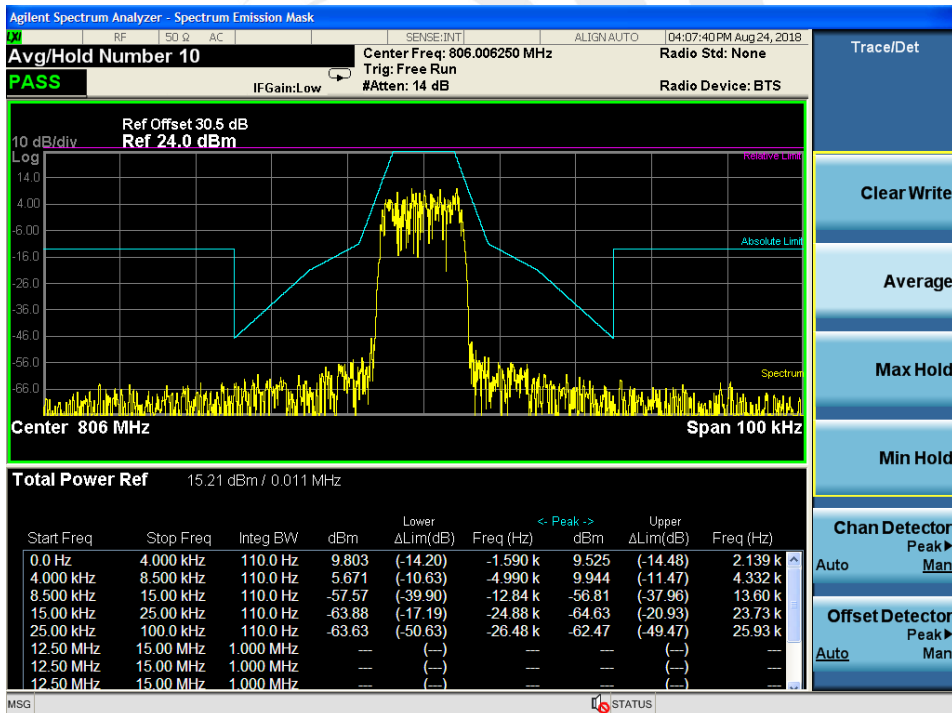
CH 1

Model 3



CH 2

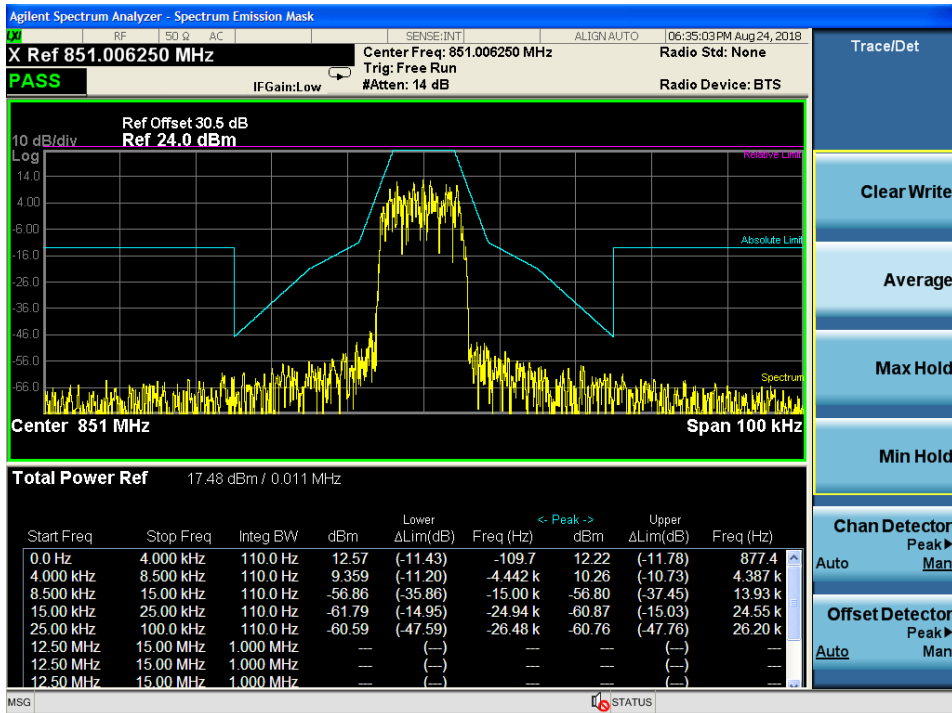
Model 4





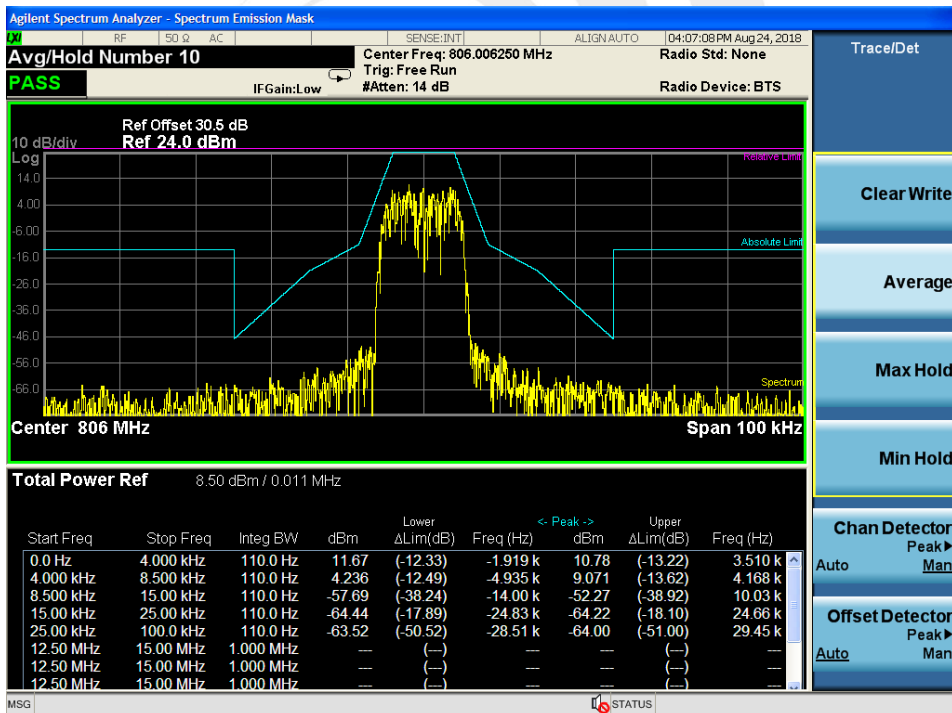
CH 1

Model 5



CH 2

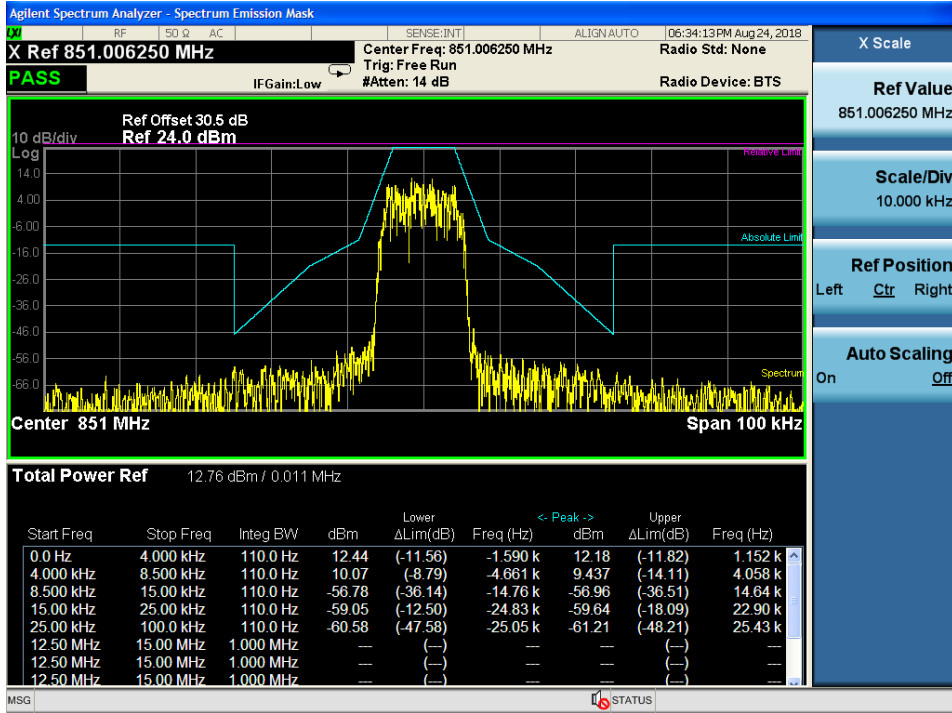
Model 6





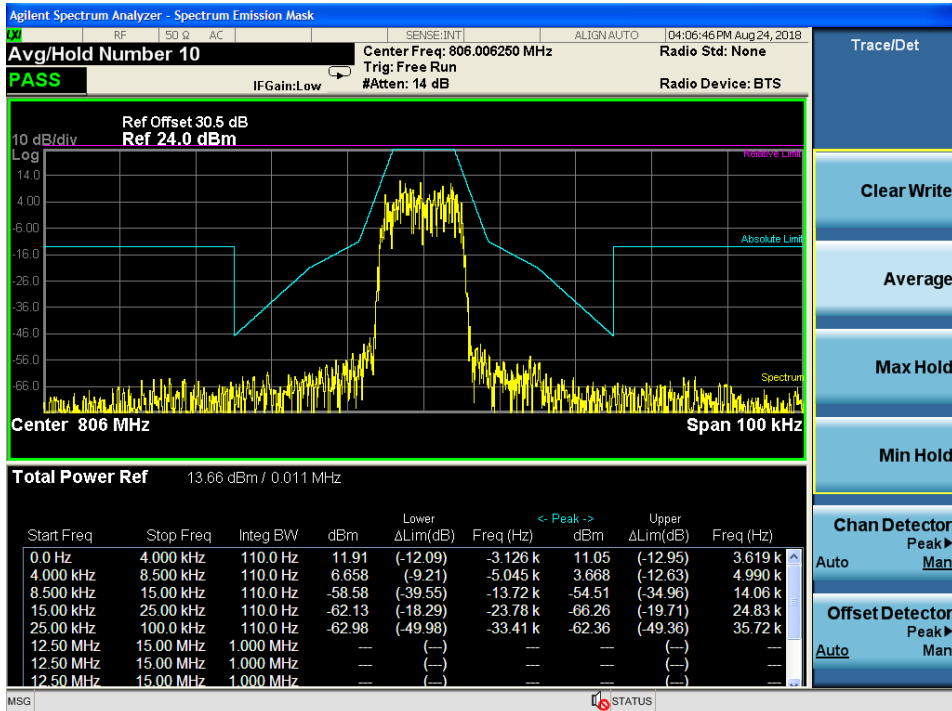
CH 1

Model 7



CH 2

Model 8



6. ADJACENT CHANNEL POWER

6.1 PROVISIONS APPLICABLE

§90.221

Frequency offset	Maximum ACP (dBc) for devices less than 15 watts	Maximum ACP (dBc) for devices 15 watts and above
25 kHz	-55 dBc	-55 dBc
50 kHz	-65 dBc	-65 dBc
75 kHz	-65 dBc	-70 dBc

b. In any case, no requirement in excess of -36 dBm shall apply.

6.2 MEASUREMENT PROCEDURE

a. The EUT was connected to the spectrum analyzer through sufficient attenuation.

b. Set EUT as digital data mode.

c. Set SPA Center Frequency=fundamental frequency, RBW=300Hz, VBW=1KHz, span =180KHz.

6.3 TEST SETUP BLOCK DIAGRAM

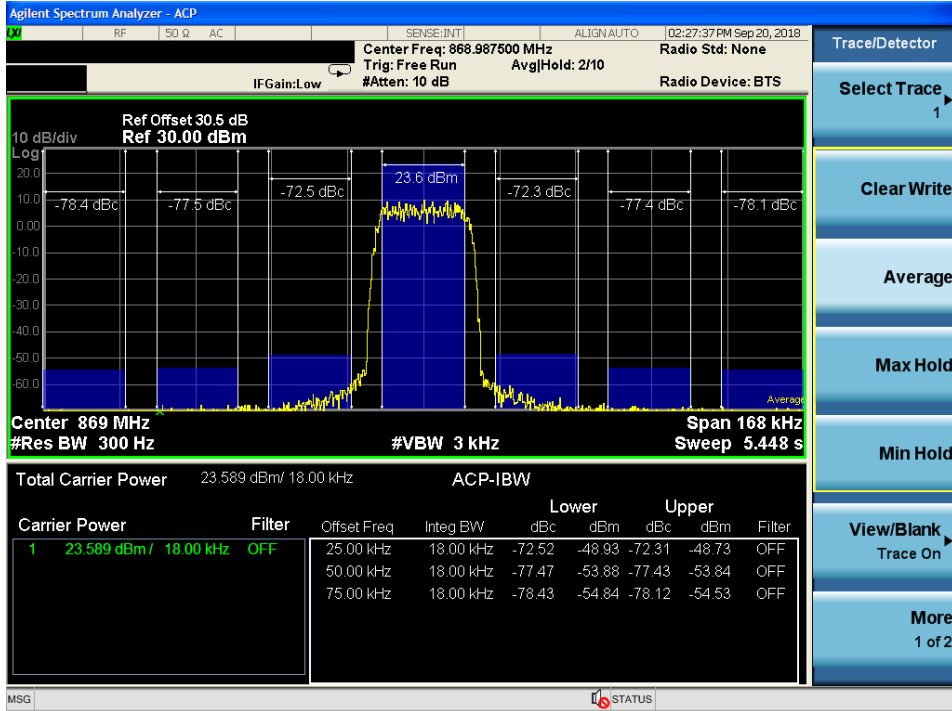




6.4 TEST RESULT

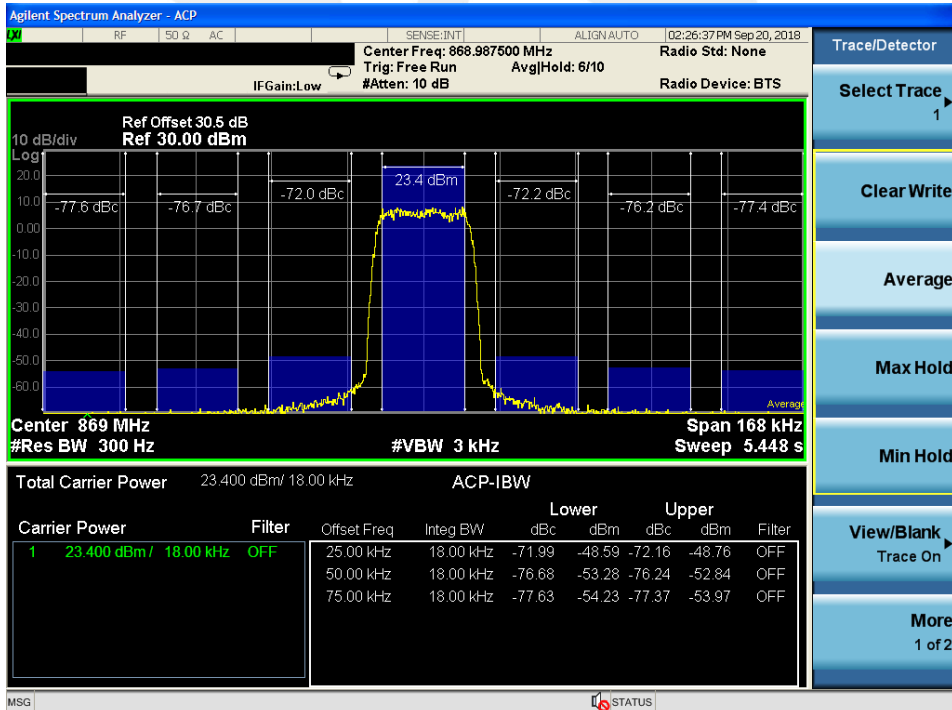
CH 3

Model 9



CH 3

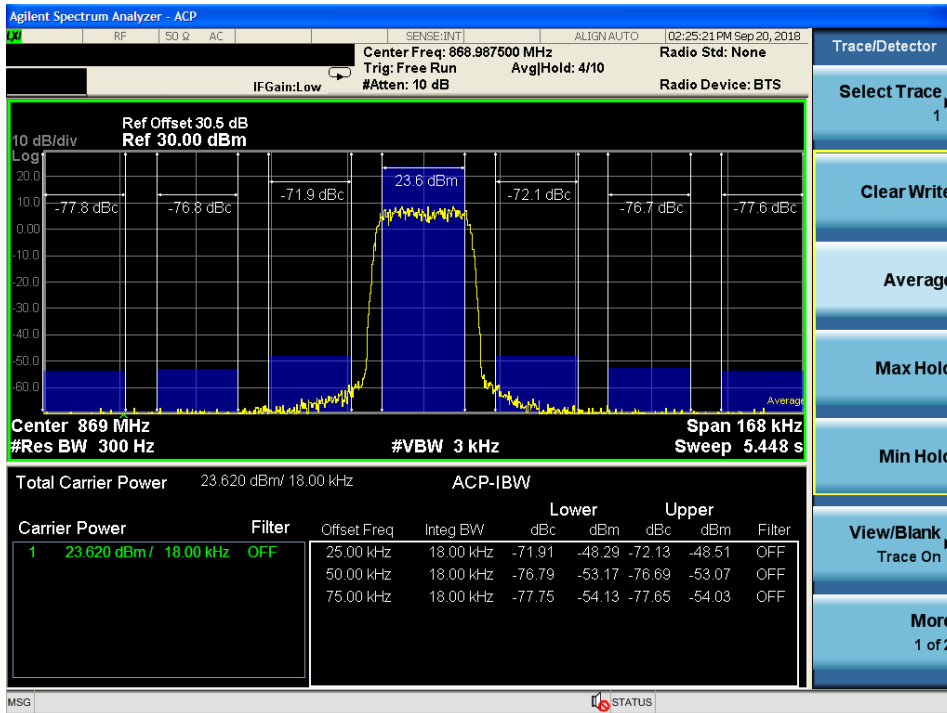
Model 13





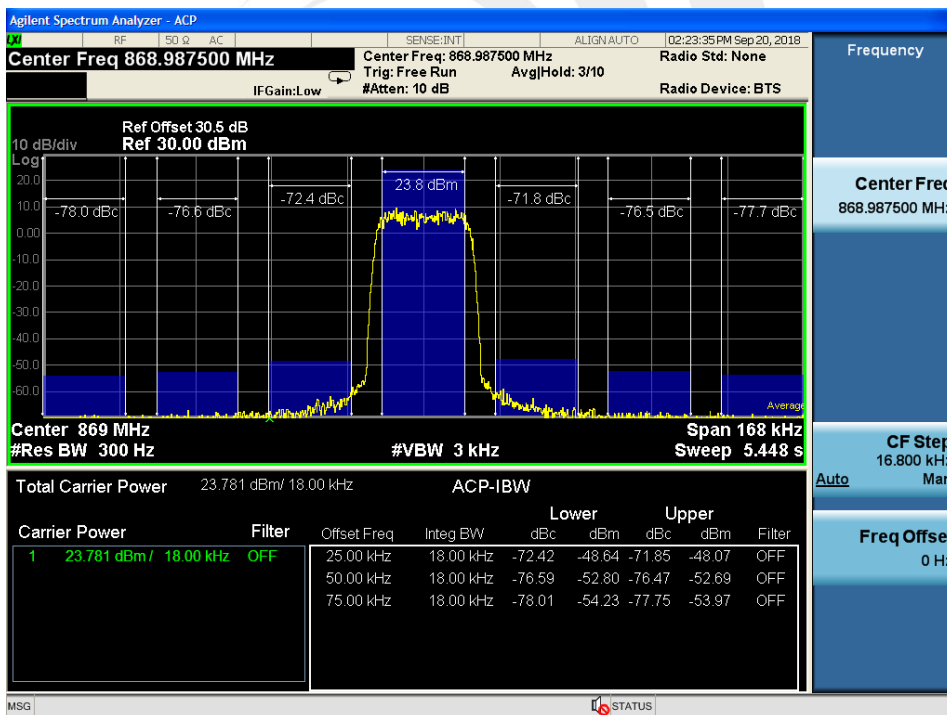
CH 3

Model 17



CH 3

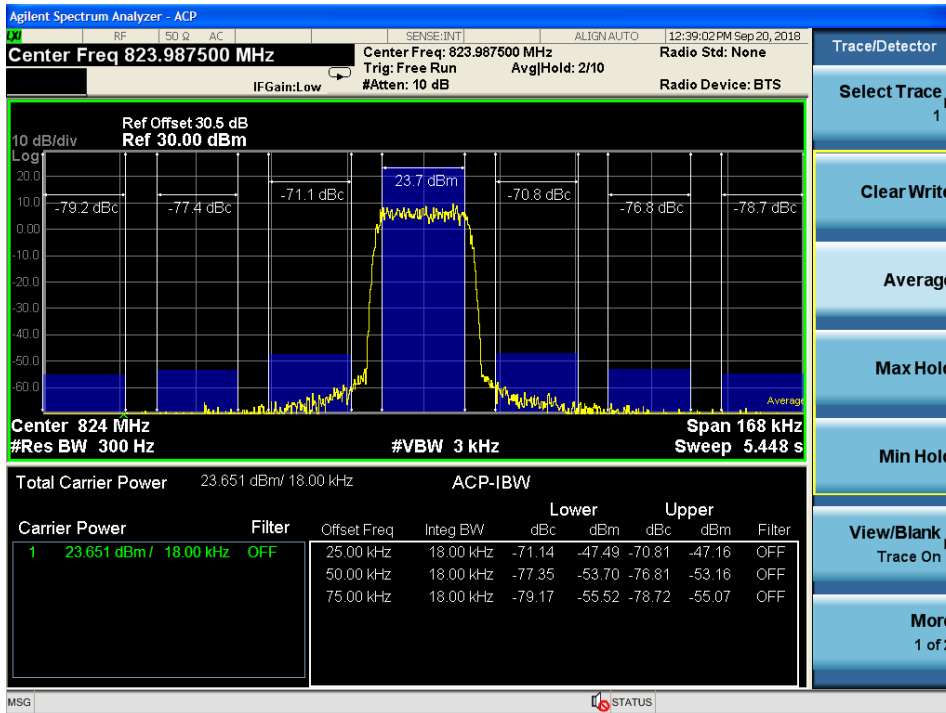
Model 21





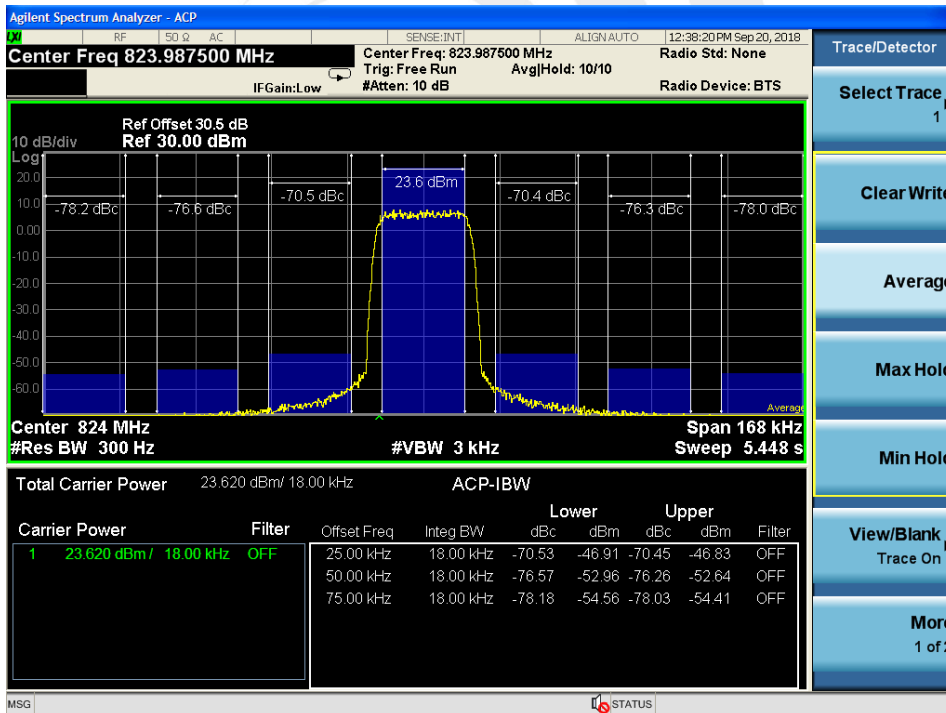
CH 4

Model 10



CH 4

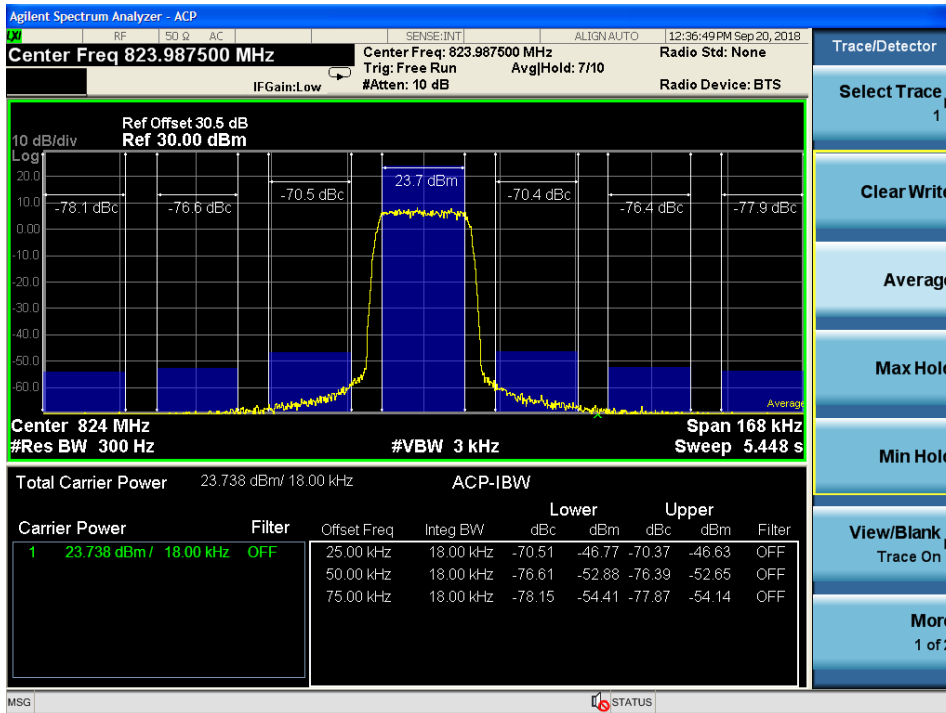
Model 14





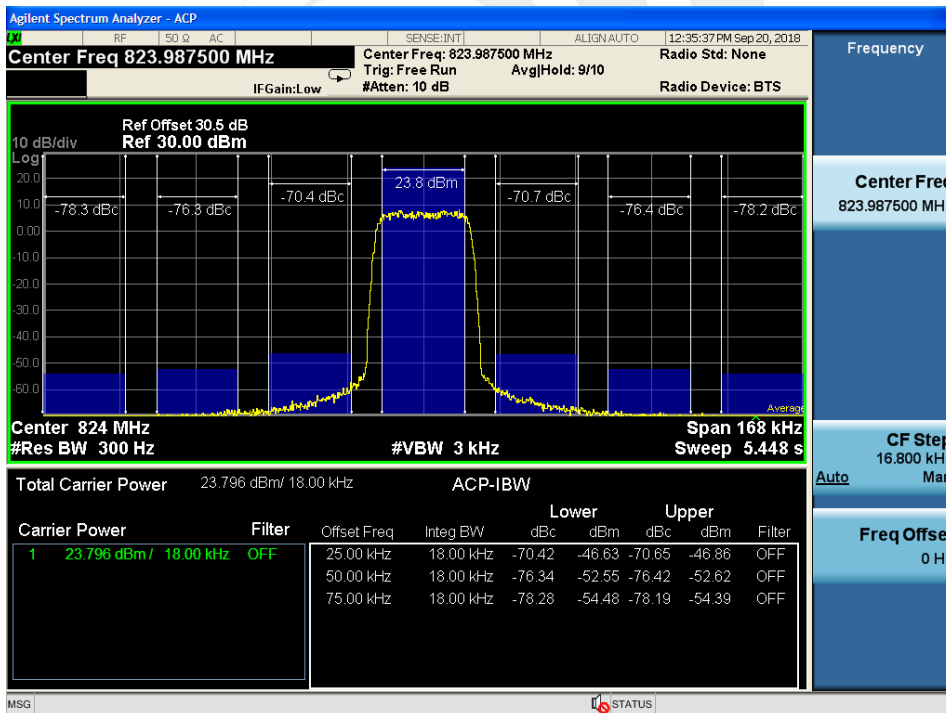
CH 4

Model 18



CH 4

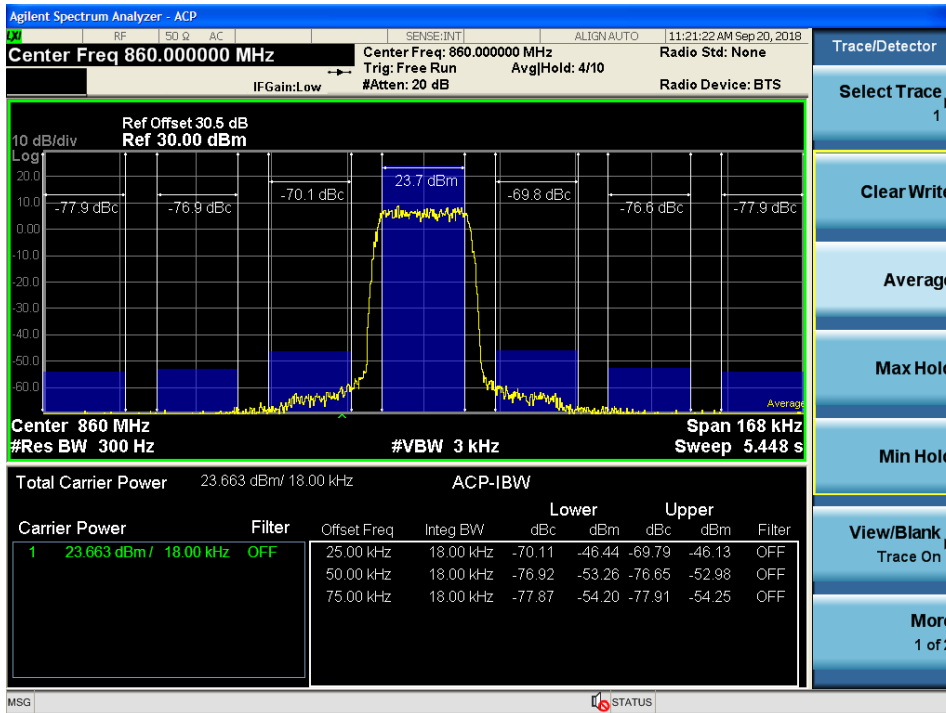
Model 22





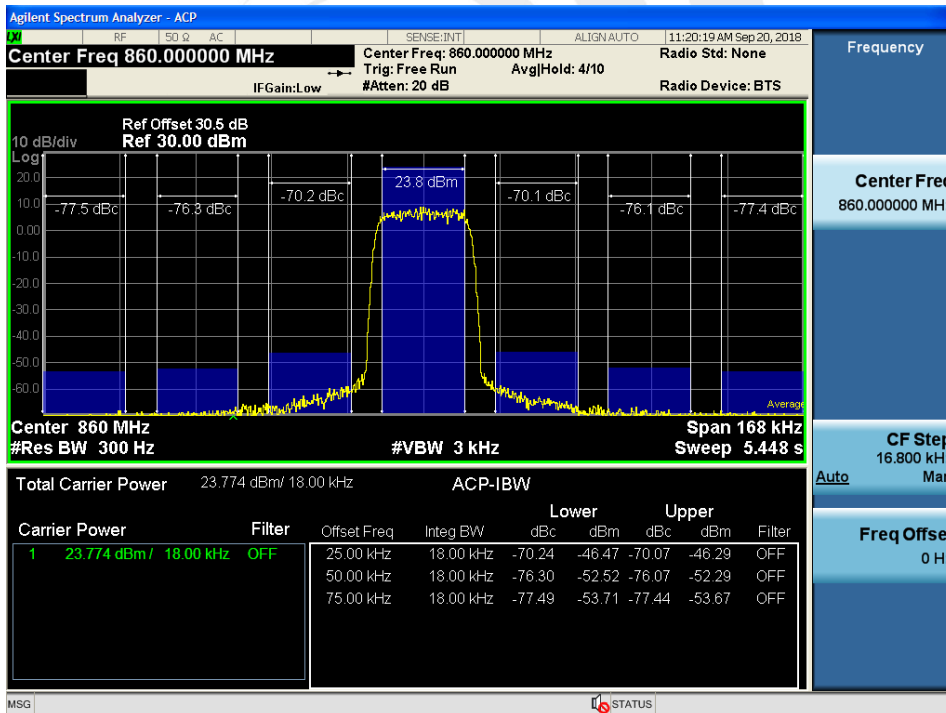
CH 5

Model 11



CH 5

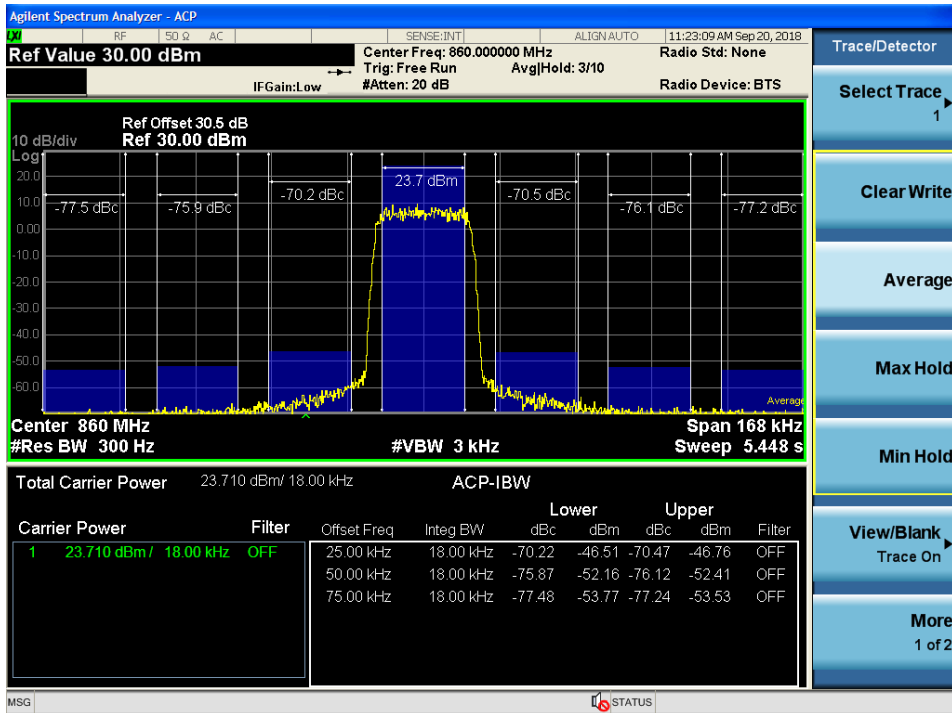
Model 15





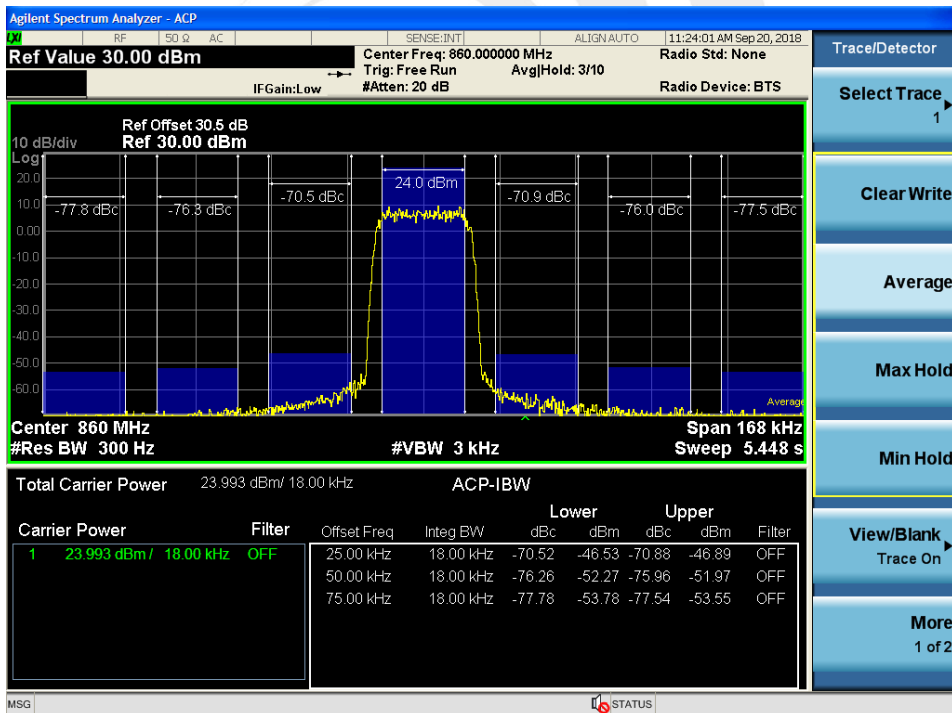
CH 5

Model 19



CH 5

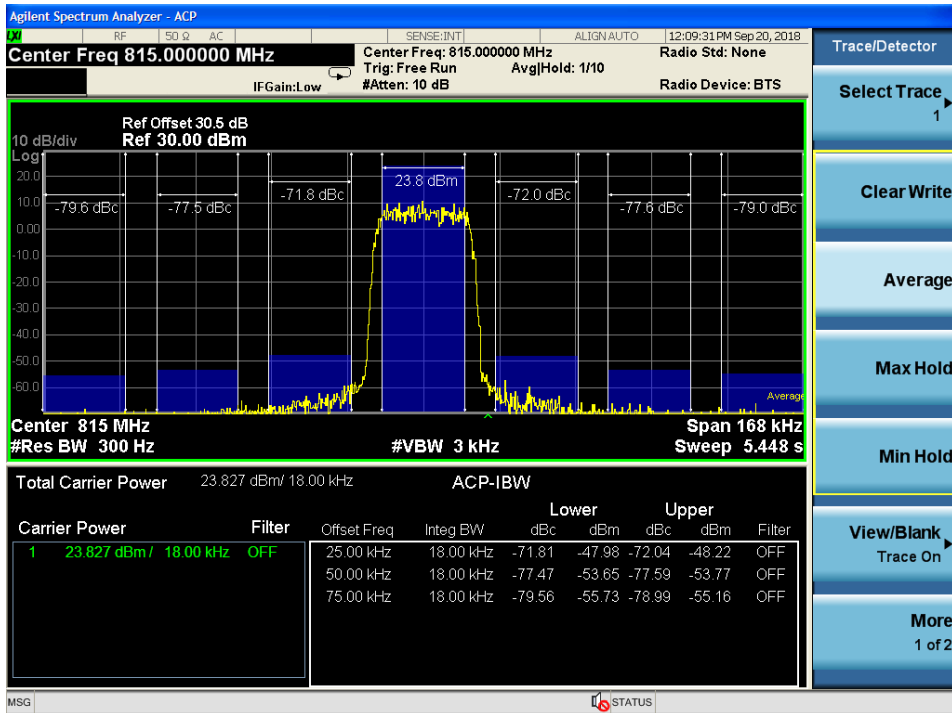
Model 23





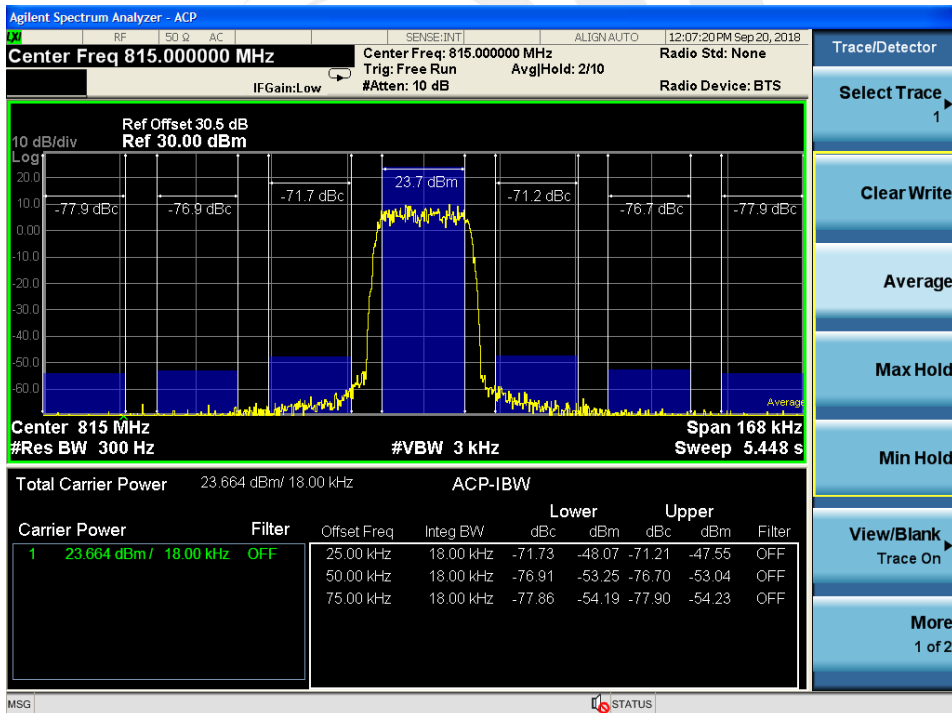
CH 6

Model 12



CH 6

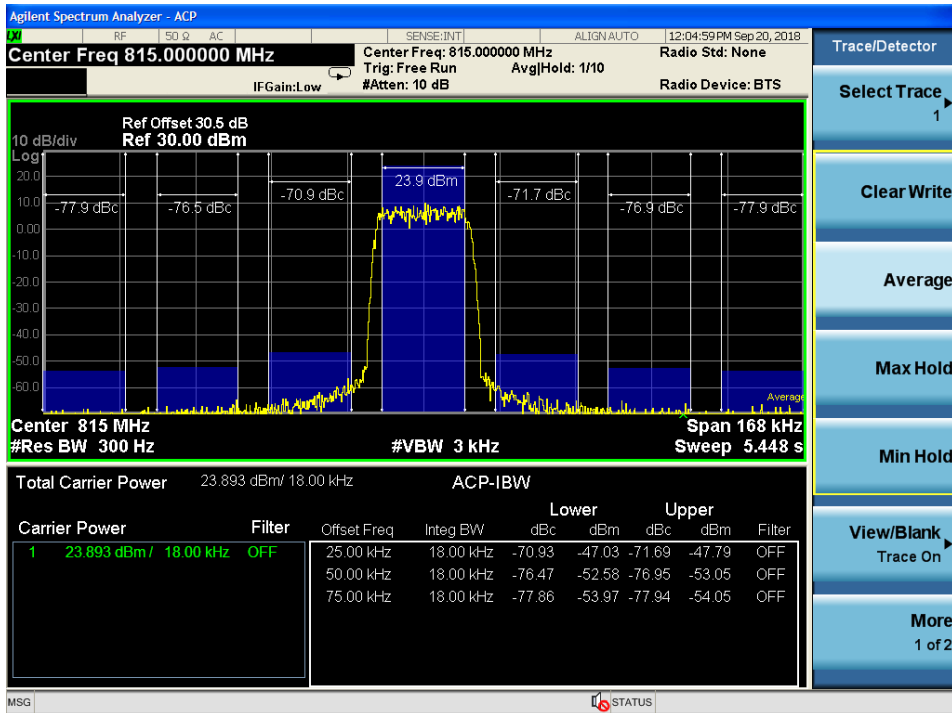
Model 16





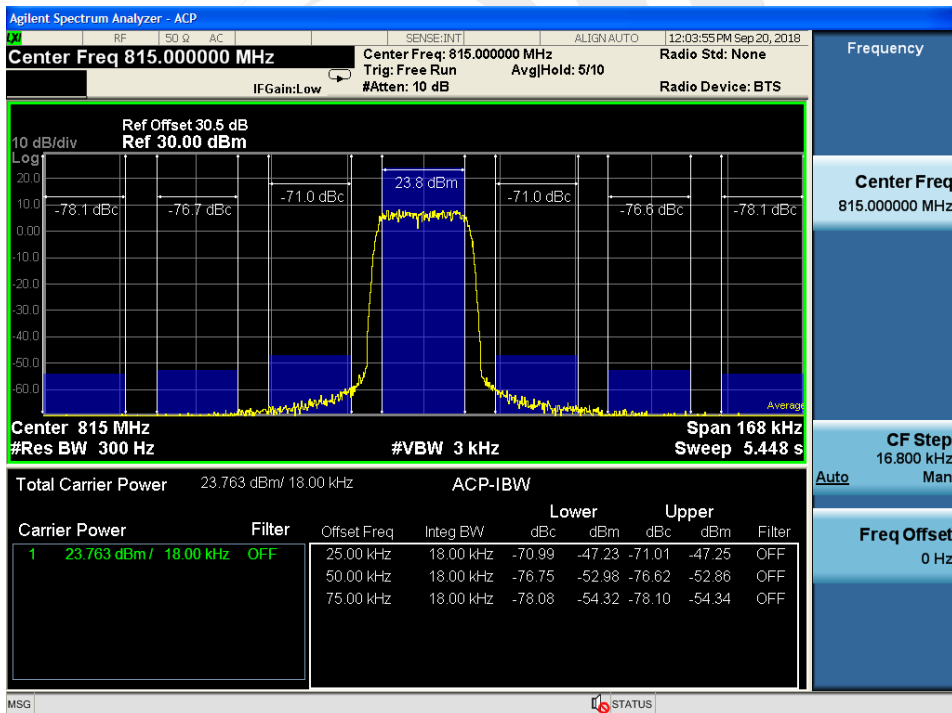
CH 6

Model 20



CH 6

Model 24





7. TRANSMITTER RADIATED SPURIOUS EMISSION

7.1 PROVISIONS APPLICABLE

According to the TIA/EIA 603 test method, and according to Section 90.210, the power of each unwanted emission shall be less than Transmitted Power as specified below for transmitters designed to operate with 12.5 KHz channel bandwidth:

- (1) On any frequency removed from the center of the authorized bandwidth by a displacement frequency (f_d in kHz) of 4 kHz or less: Zero dB.
- (2) On any frequency removed from the center of the authorized bandwidth by a displacement frequency (f_d in kHz) of more than 4 kHz, but no more than 8.5 kHz: At least $107 \log (f_d/4)$ dB;
- (3) On any frequency removed from the center of the authorized bandwidth by a displacement frequency (f_d in kHz) of more than 8.5 kHz, but no more than 15 kHz: At least $40.5 \log (f_d/1.16)$ dB;
- (4) On any frequency removed from the center of the authorized bandwidth by a displacement frequency (f_d in kHz) of more than 15 kHz, but no more than 25 kHz: At least $116 \log (f_d/6.1)$ dB;
- (5) On any frequency removed from the center of the authorized bandwidth by more than 25 kHz: At least $43 + 10 \log (P)$ dB.

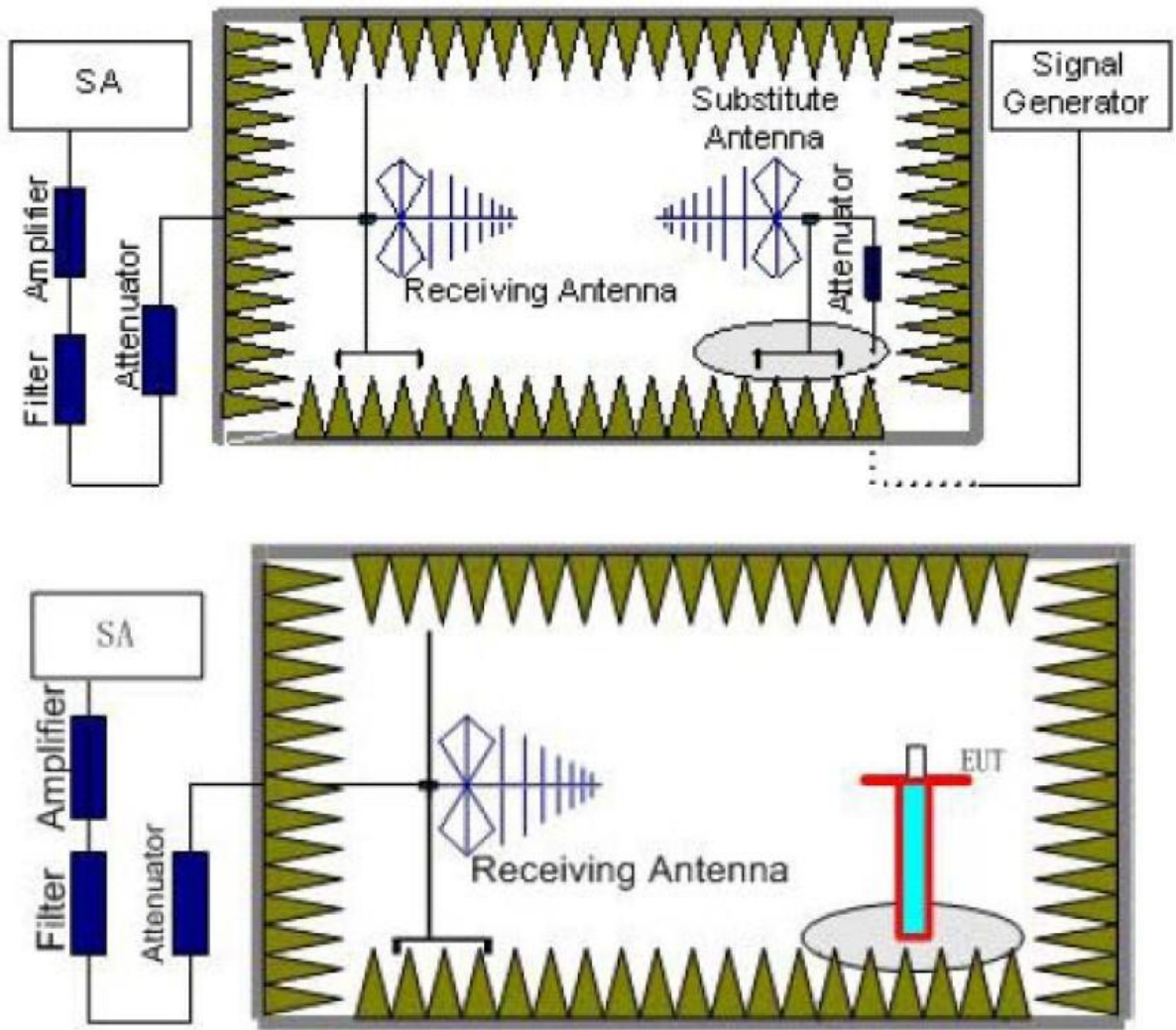
For transmitters designed to transmit with 25 KHz channel separation and equipped with an audio low-pass filter, the power of any emission must be attenuated below the unmodulated carrier power (P) as following:

- (1) On any frequency removed from the assigned frequency by more than 75 kHz, the attenuation of any emission must be at least $43 + 10 \log (P_{\text{watts}})$ dB.

7.2 TEST PROCEDURE

- a. EUT was placed on a 1.50 meter high non-conductive stand at a 3 meter test distance from the receive antenna. A receiving antenna was placed on the antenna mast 3 meters from the EUT. for emission measurements. The height of receiving antenna is 1.50 m. Detected emissions were maximized at each frequency by rotating the EUT through 360° and adjusting the receiving antenna polarization. The radiated emission measurements of all transmit frequencies in six channels were measured with peak detector.
- b. A log-periodic antenna or double-ridged waveguide horn antenna shall be substituted in place of the EUT. The log-periodic antenna will be driven by a signal generator and the level will be adjusted till the same power value on the spectrum analyzer or receiver. The level of the spurious emissions can be calculated through the level of the signal generator, cable loss, the gain of the substitution antenna and the reading of the spectrum analyzer or receiver.
- c. The EUT is then put into continuously transmitting mode at its maximum power level during the test. Set Test Receiver or Spectrum RBW=1MHz, VBW=3MHz for above 1GHz and RBW=100KHz, VBW=300KHz for 30MHz to 1GHz, And the maximum value of the receiver should be recorded as (P_r).
- d. The EUT shall be replaced by a substitution antenna. In the chamber, an substitution antenna for the frequency band of interest is placed at the reference point of the chamber. An RF Signal source for the frequency band of interest is connected to the substitution antenna with a cable that has been constructed to not interfere with the radiation pattern of the antenna. A power (P_{Mea}) is applied to the input of the substitution antenna, and adjust the level of the signal generator output until the value of the receiver reach the previously recorded (P_r). The power of signal source (P_{Mea}) is recorded. The test should be performed by rotating the test item and adjusting the receiving antenna polarization.
- e. A amplifier should be connected to the Signal Source output port. And the cable should be connect between the Amplifier and the Substitution Antenna. The cable loss (P_{cl}), the Substitution Antenna Gain (G_a) and the Amplifier Gain (P_{Ag}) should be recorded after test. The measurement results are obtained as described below:
Amplifier for substitution test; The measurement results are amend as described below:
$$\text{Power(EIRP)} = P_{\text{Mea}} - P_{\text{cl}} + G_a$$

7.3 TEST CONFIGURATION





7.4 TEST RESULT

CH 1				Model 1			
Frequency	Result					Limit (dBm)	Conclusion
	P _{meas} (dBm)	Cable loss	Antenna Gain(dBi)	P _{Meas} E.I.R.P(dBm)	Polarization		
					Of Max. EIRP		
1702.0125	-55.35	3.17	9.8	-48.72	Horizontal	-13.00	Pass
2553.01875	-53.14	3.47	10.7	-45.91	Horizontal	-13.00	Pass
3404.025	-53.28	3.93	12.3	-44.91	Horizontal	-13.00	Pass
1702.0125	-52.85	3.17	9.8	-46.22	Vertical	-13.00	Pass
2553.01875	-52.17	3.47	10.7	-44.94	Vertical	-13.00	Pass
3404.025	-51.94	3.93	12.3	-43.57	Vertical	-13.00	Pass

CH 2				Model 2			
Frequency	Result					Limit (dBm)	Conclusion
	P _{meas} (dBm)	Cable loss	Antenna Gain(dBi)	P _{Meas} E.I.R.P(dBm)	Polarization		
					Of Max. EIRP		
1612.0125	-52.73	2.85	9.4	-46.18	Horizontal	-13.00	Pass
2418.01875	-55.56	3.47	10.5	-48.53	Horizontal	-13.00	Pass
3224.025	-52.08	4.17	11.8	-44.45	Horizontal	-13.00	Pass
1612.0125	-55.17	2.85	9.4	-48.62	Vertical	-13.00	Pass
2418.01875	-52.25	3.47	10.5	-45.22	Vertical	-13.00	Pass
3224.025	-55.49	4.17	11.8	-47.86	Vertical	-13.00	Pass

CH 3				Model 9			
Frequency	Result					Limit (dBm)	Conclusion
	P _{meas} (dBm)	Cable loss	Antenna Gain(dBi)	P _{Meas} E.I.R.P(dBm)	Polarization		
					Of Max. EIRP		
1737.975	-54.62	3.17	9.8	-47.99	Horizontal	-13.00	Pass
2606.9625	-54.17	3.47	10.7	-46.94	Horizontal	-13.00	Pass
3475.95	-53.88	3.93	12.3	-45.51	Horizontal	-13.00	Pass
1737.975	-55.71	3.17	9.8	-49.08	Vertical	-13.00	Pass
2606.9625	-53.94	3.47	10.7	-46.71	Vertical	-13.00	Pass
3475.95	-52.87	3.93	12.3	-44.50	Vertical	-13.00	Pass



CH 4				Model 10			
Frequency	Result					Limit (dBm)	Conclusion
	P _{meas} (dBm)	Cable loss	Antenna Gain(dBi)	P _{Meas} E.I.R.P.(dBm)	Polarization Of Max. EIRP		
1647.975	-55.10	2.85	9.4	-48.55	Horizontal	-13.00	Pass
2471.9625	-55.37	3.47	10.5	-48.34	Horizontal	-13.00	Pass
3295.95	-51.09	4.17	11.8	-43.46	Horizontal	-13.00	Pass
1647.975	-56.47	2.85	9.4	-49.92	Vertical	-13.00	Pass
2471.9625	-54.26	3.47	10.5	-47.23	Vertical	-13.00	Pass
3295.95	-53.79	4.17	11.8	-46.16	Vertical	-13.00	Pass

CH 5				Model 11			
Frequency	Result					Limit (dBm)	Conclusion
	P _{meas} (dBm)	Cable loss	Antenna Gain(dBi)	P _{Meas} E.I.R.P.(dBm)	Polarization Of Max. EIRP		
1720	-54.11	3.17	9.8	-47.48	Horizontal	-13.00	Pass
2580	-53.48	3.47	10.7	-46.25	Horizontal	-13.00	Pass
3440	-52.63	3.93	12.3	-44.26	Horizontal	-13.00	Pass
1720	-55.18	3.17	9.8	-48.55	Vertical	-13.00	Pass
2580	-53.64	3.47	10.7	-46.41	Vertical	-13.00	Pass
3440	-54.17	3.93	12.3	-45.80	Vertical	-13.00	Pass

CH 6				Model 12			
Frequency	Result					Limit (dBm)	Conclusion
	P _{meas} (dBm)	Cable loss	Antenna Gain(dBi)	P _{Meas} E.I.R.P.(dBm)	Polarization Of Max. EIRP		
1630	-54.24	2.85	9.4	-47.69	Horizontal	-13.00	Pass
2445	-54.73	3.47	10.5	-47.70	Horizontal	-13.00	Pass
3260	-51.29	4.17	11.8	-43.66	Horizontal	-13.00	Pass
1630	-55.47	2.85	9.4	-48.92	Vertical	-13.00	Pass
2445	-54.26	3.47	10.5	-47.23	Vertical	-13.00	Pass
3260	-54.55	4.17	11.8	-46.92	Vertical	-13.00	Pass

Note: $EIRP = P_{Mea}(dBm) - P_{cl}(dB) + G_a(dBi)$

We were not recorded other points as values lower than limits

8. SPURIOUS EMSSION ON ANTENNA PORT

8.1 PROVISIONS APPLICABLE

According to the TIA/EIA 603 test method, and according to Section 90.210, the power of each unwanted emission shall be less than Transmitted Power as specified below for transmitters designed to operate with 12.5 KHz channel bandwidth:

- (1) On any frequency removed from the center of the authorized bandwidth by a displacement frequency (f_d in kHz) of 4 kHz or less: Zero dB.
- (2) On any frequency removed from the center of the authorized bandwidth by a displacement frequency (f_d in kHz) of more than 4 kHz, but no more than 8.5 kHz: At least $107 \log (f_d/4)$ dB;
- (3) On any frequency removed from the center of the authorized bandwidth by a displacement frequency (f_d in kHz) of more than 8.5 kHz, but no more than 15 kHz: At least $40.5 \log (f_d/1.16)$ dB;
- (4) On any frequency removed from the center of the authorized bandwidth by a displacement frequency (f_d in kHz) of more than 15 kHz, but no more than 25 kHz: At least $116 \log (f_d/6.1)$ dB;
- (5) On any frequency removed from the center of the authorized bandwidth by more than 25 kHz: At least $43 + 10 \log (P)$ dB.

For transmitters designed to transmit with 25 KHz channel separation and equipped with an audio low-pass filter, the power of any emission must be attenuated below the unmodulated carrier power (P) as following:

- (1) On any frequency removed from the assigned frequency by more than 75 kHz, the attenuation of any emission must be at least $43 + 10 \log (P_{\text{watts}})$ dB.

8.2 MEASUREMENT PROCEDURE

- a. The EUT was connected to the spectrum analyzer through sufficient attenuation.
- b. Sufficient scans were taken to show any out of band emission up to 10th. Harmonic for the lower and the highest frequency range.
- c. Set EUT as digital data mode.
- d. Set RBW 100kHz, VBW 300 kHz in the frequency band 30MHz to 1GHz, while set RBW=1MHz. VBW=3MHz from the 1GHz to 10th Harmonic.

8.3 TEST SETUP BLOCK DIAGRAM

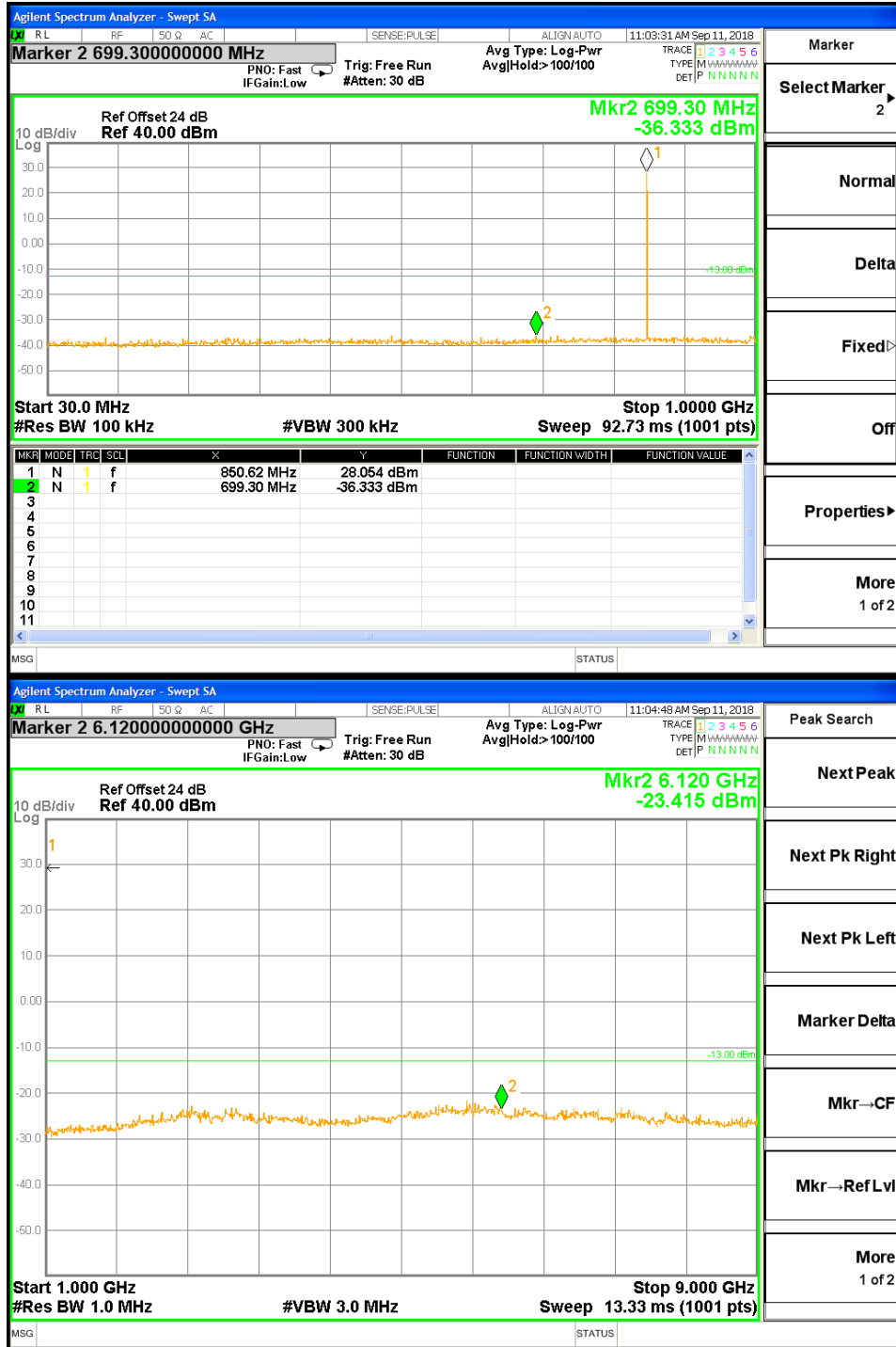




8.4 TEST RESULT

CH 1

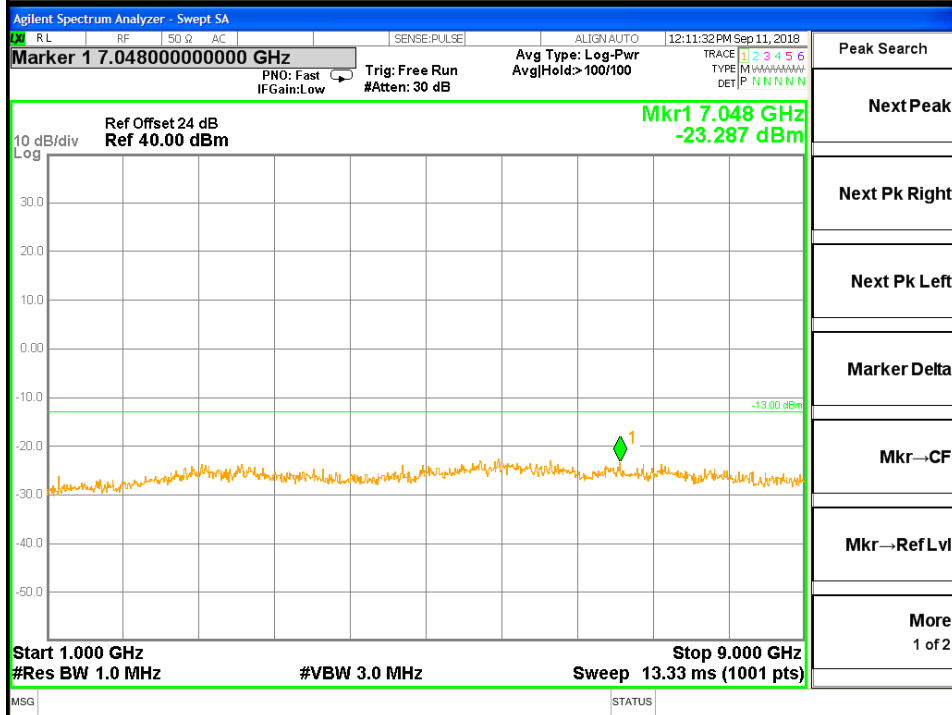
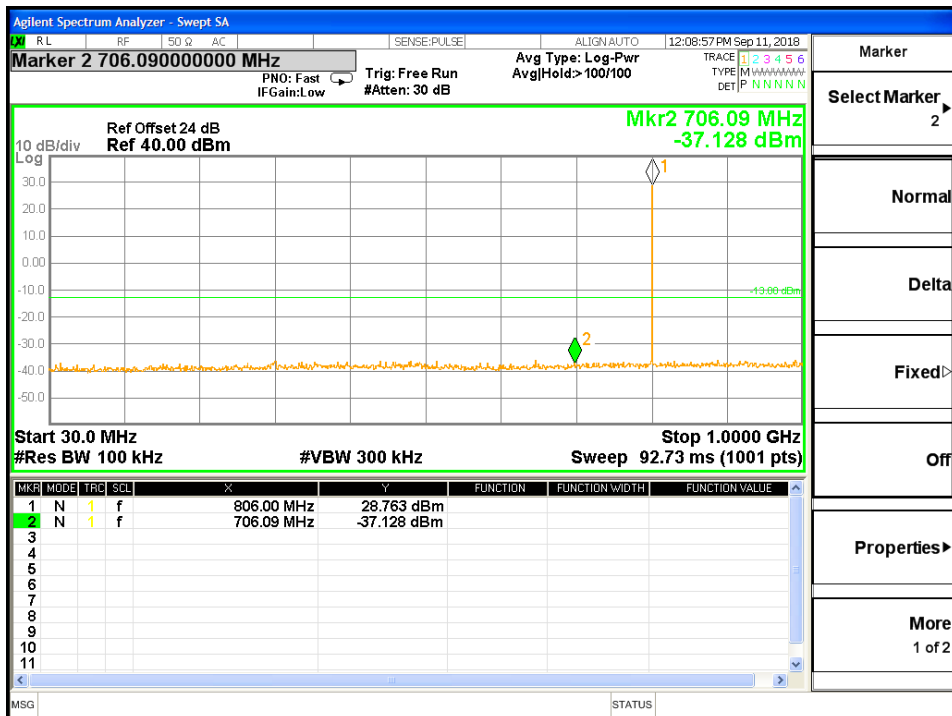
Model 1





CH 2

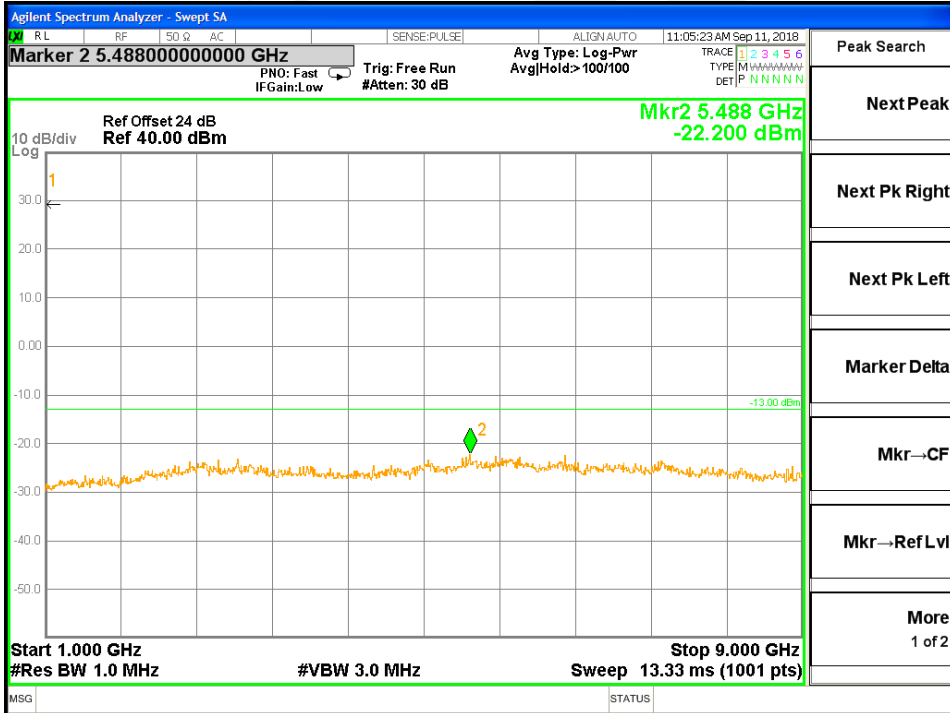
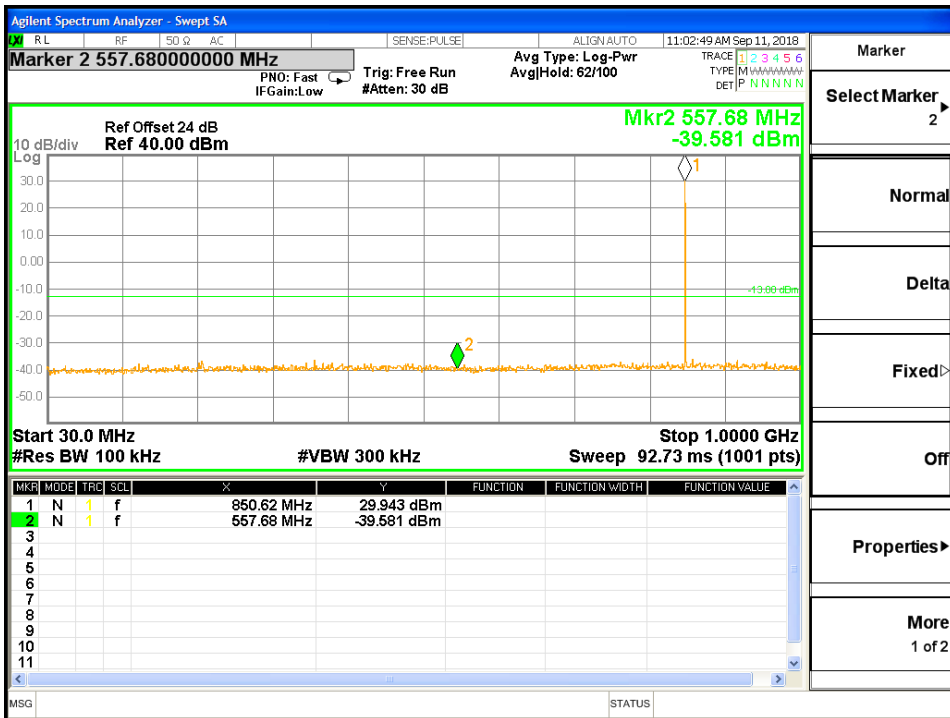
Model 2





CH 1

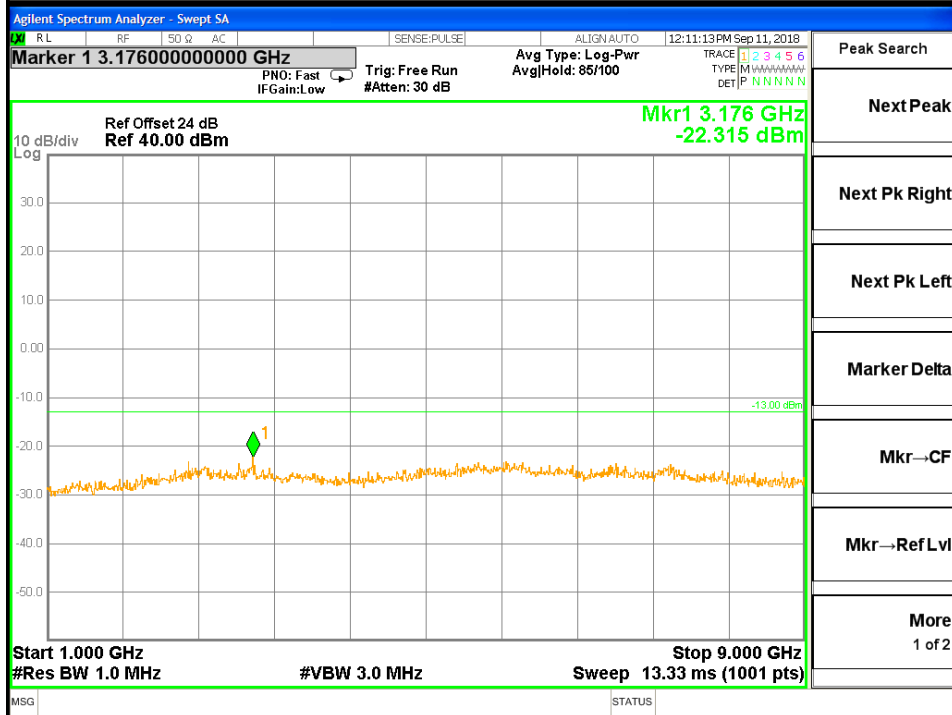
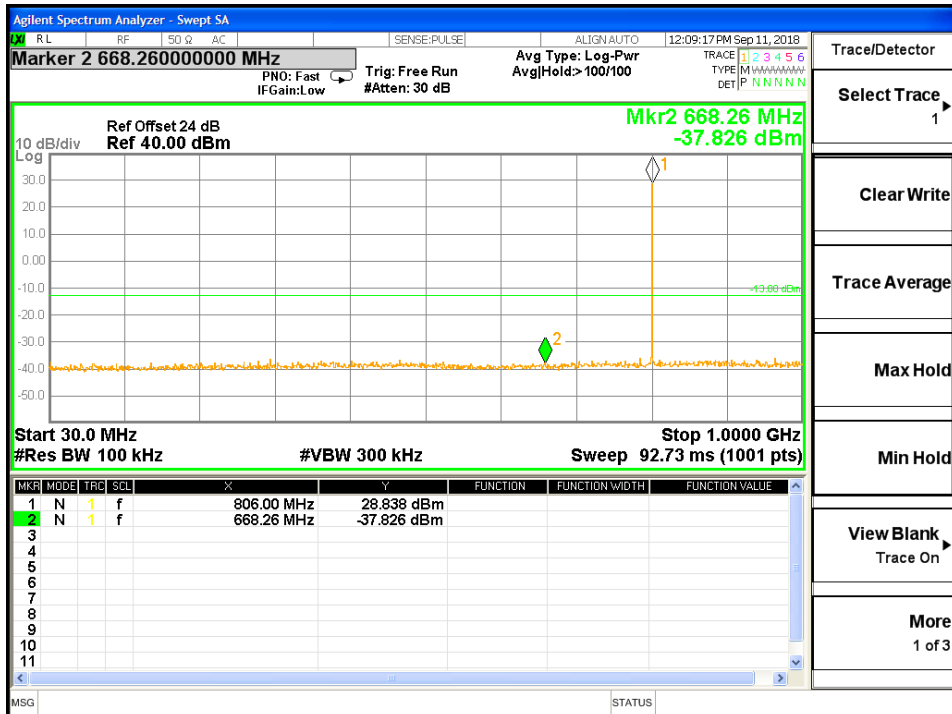
Model 3





CH 2

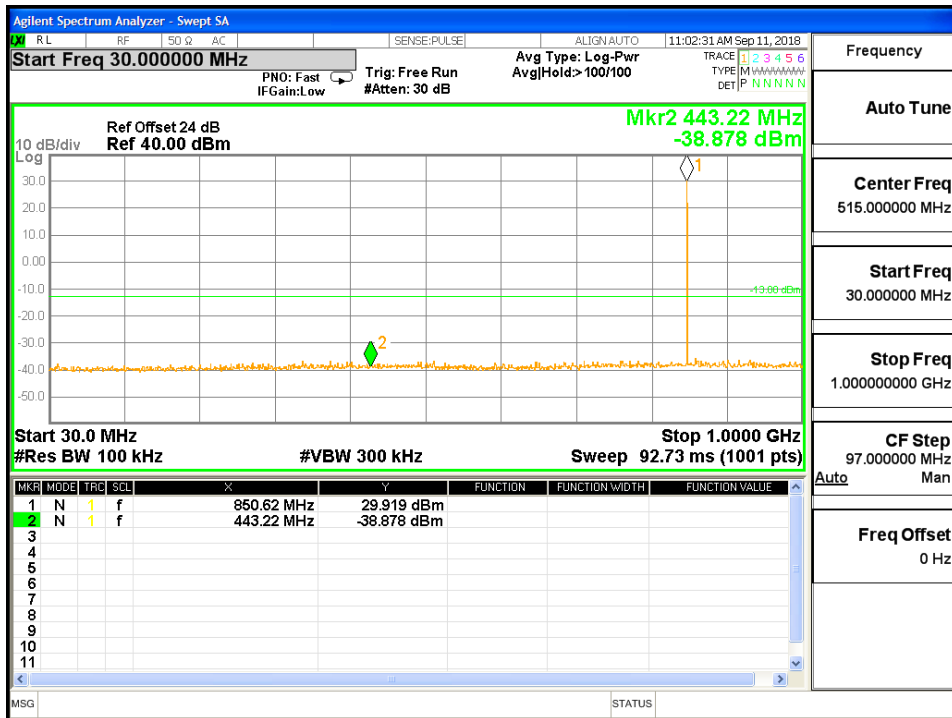
Model 4



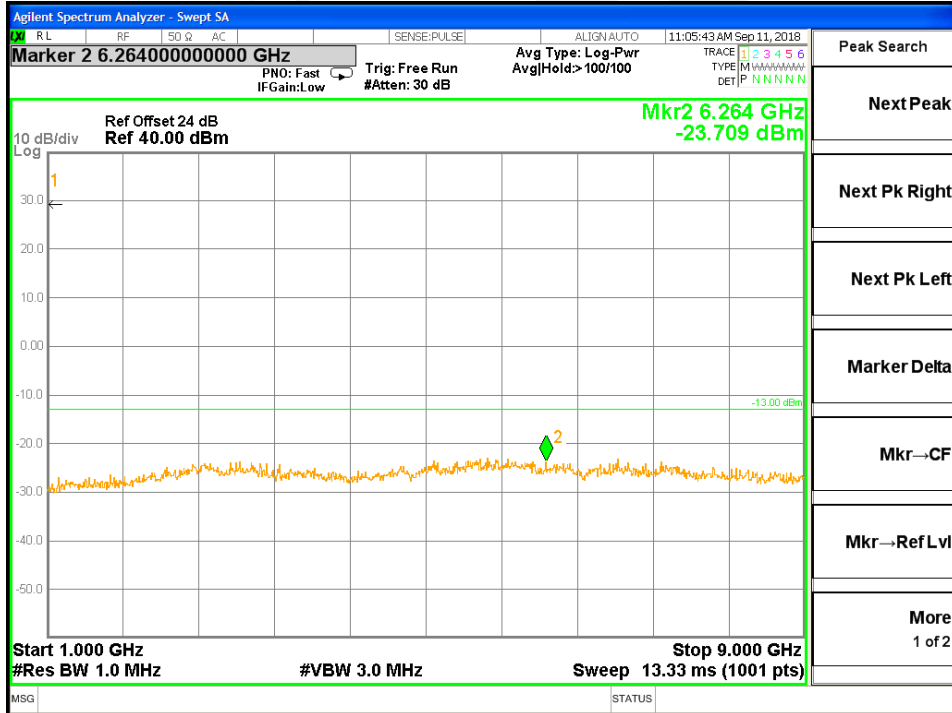


CH 1

Model 5



Frequency	
Auto Tune	
Center Freq	515.000000 MHz
Start Freq	30.000000 MHz
Stop Freq	1.000000000 GHz
CF Step	97.000000 MHz
Freq Offset	0 Hz

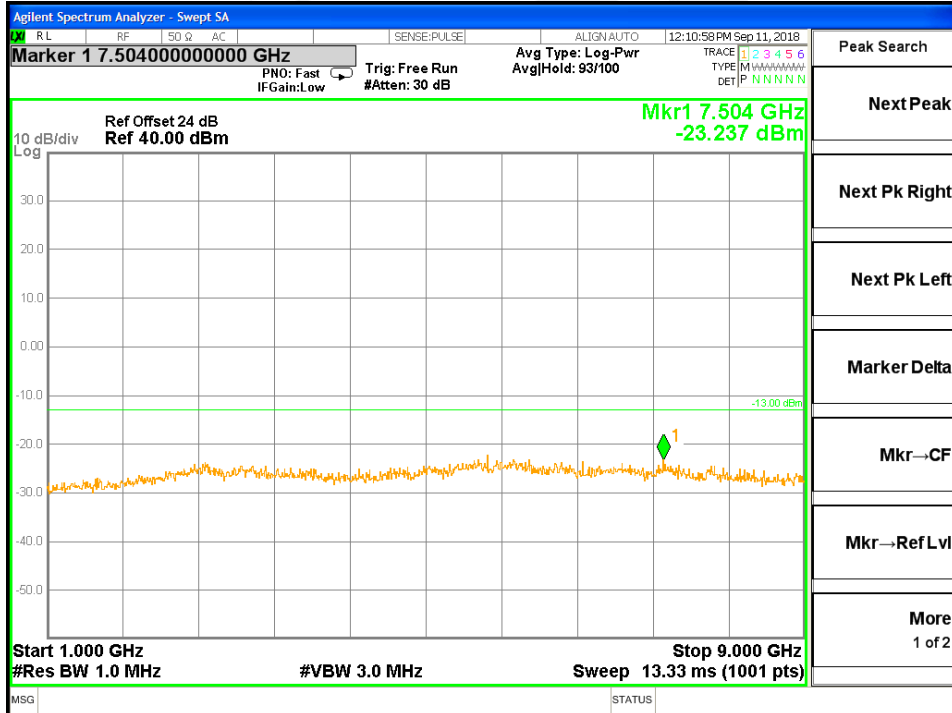
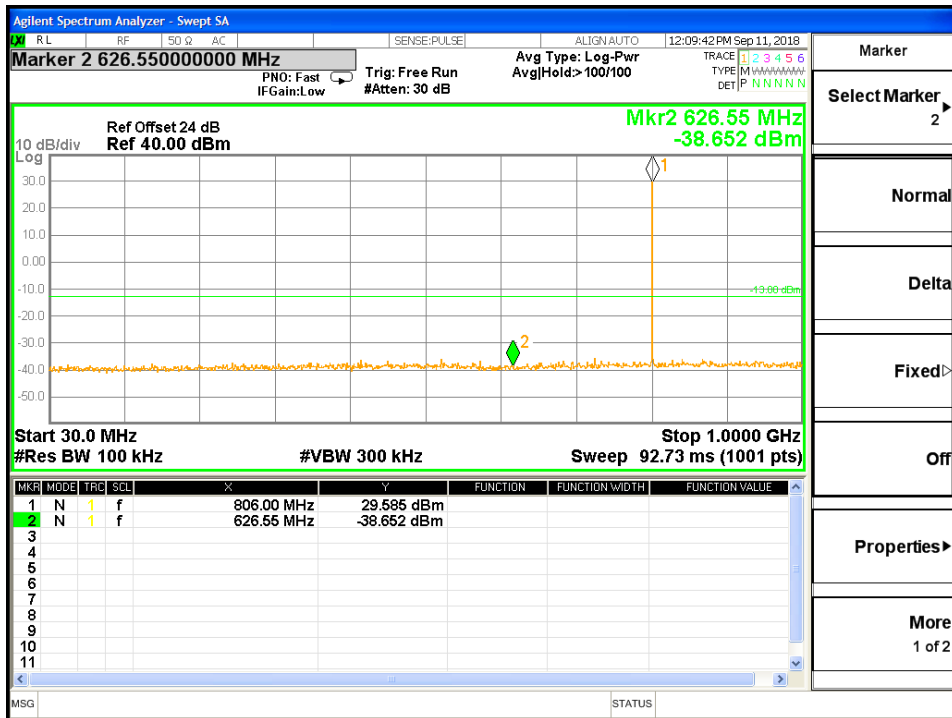


Peak Search	
Next Peak	
Next Pk Right	
Next Pk Left	
Marker Delta	
Mkr→CF	
Mkr→Ref Lvl	
More	1 of 2



CH 2

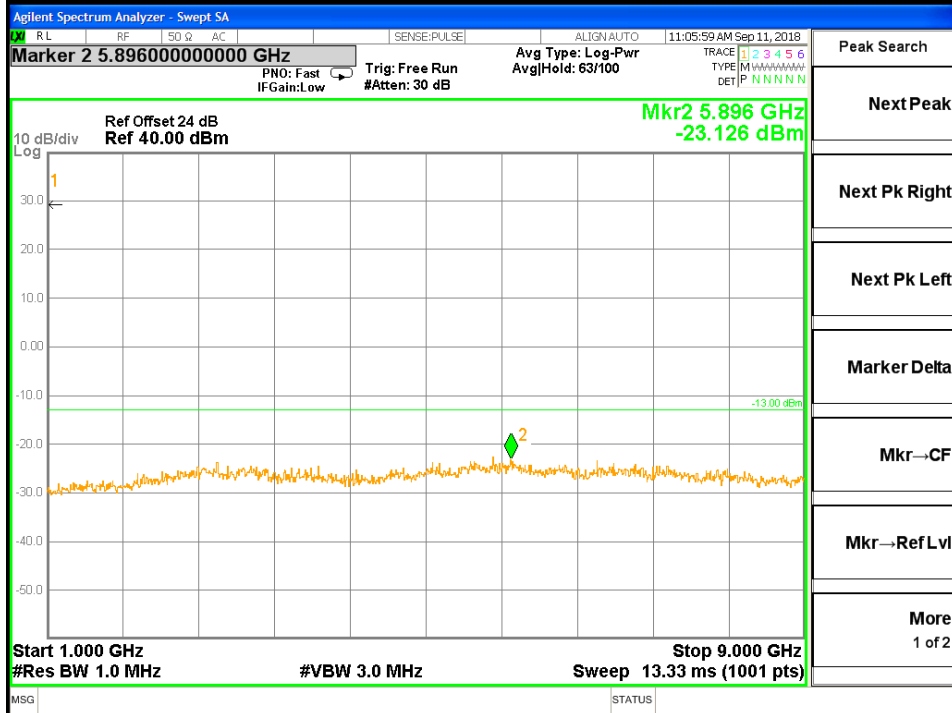
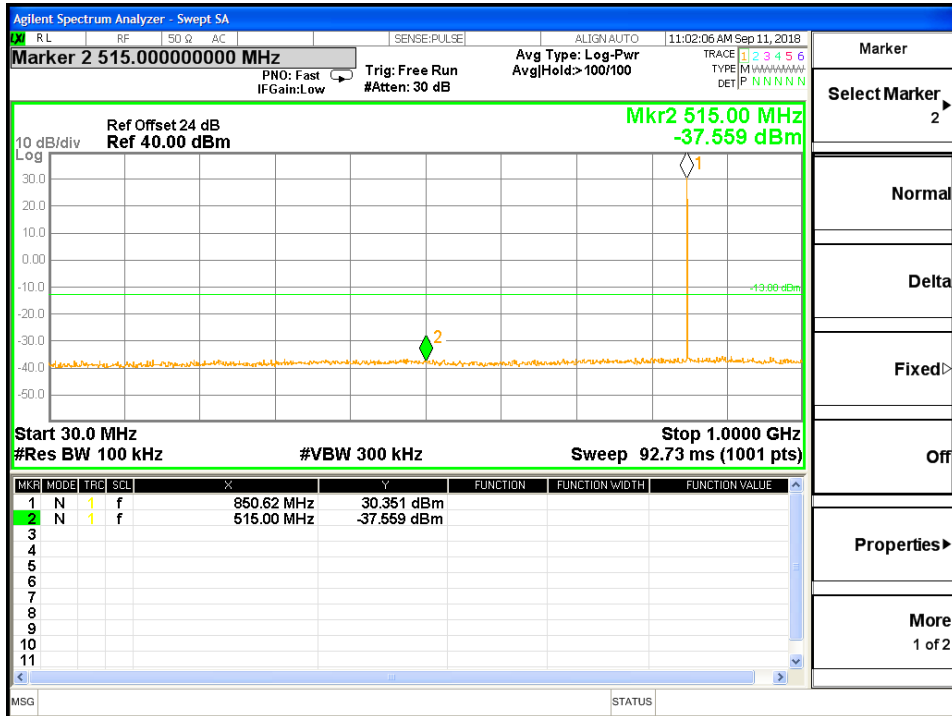
Model 6





CH 1

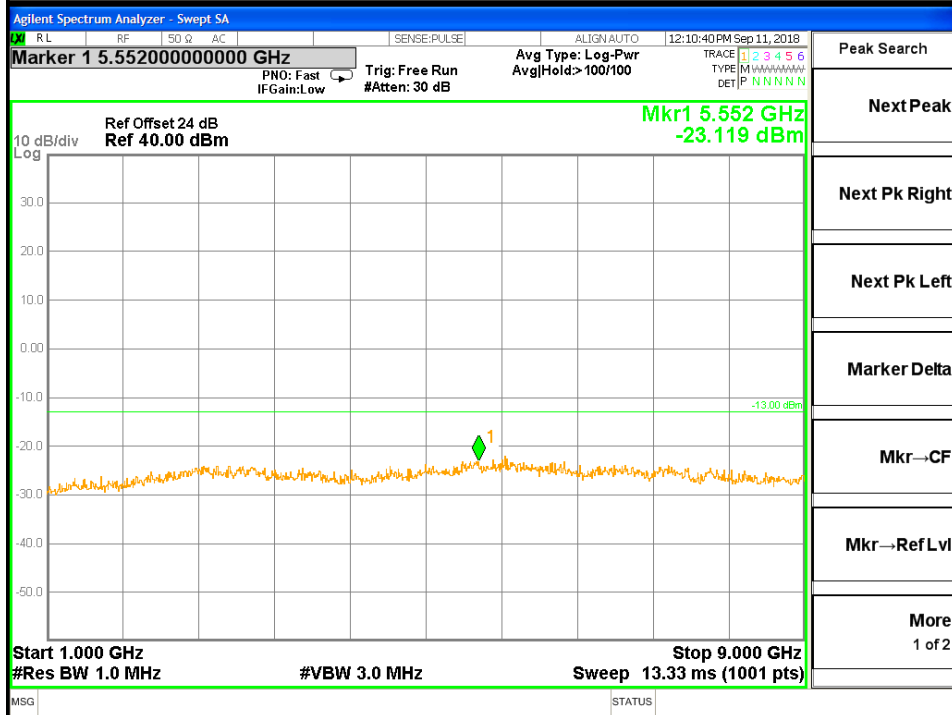
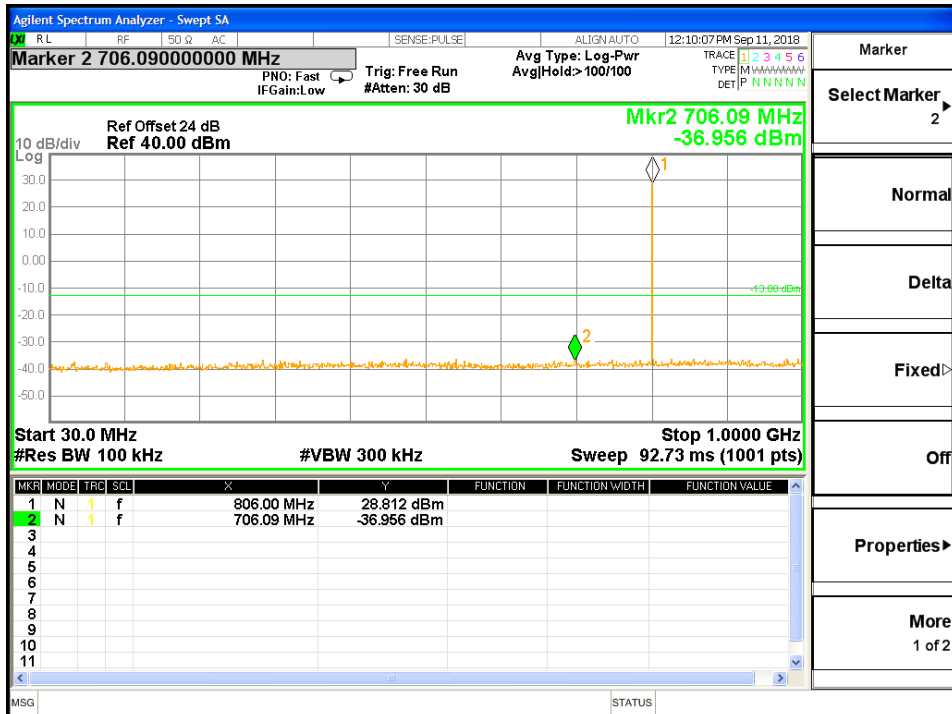
Model 7





CH 2

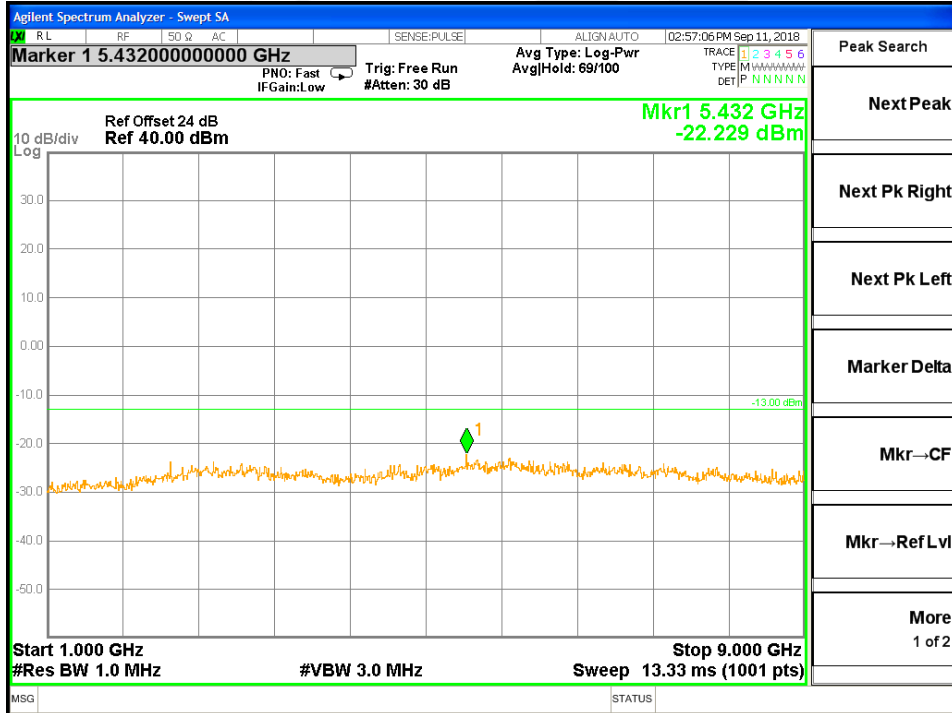
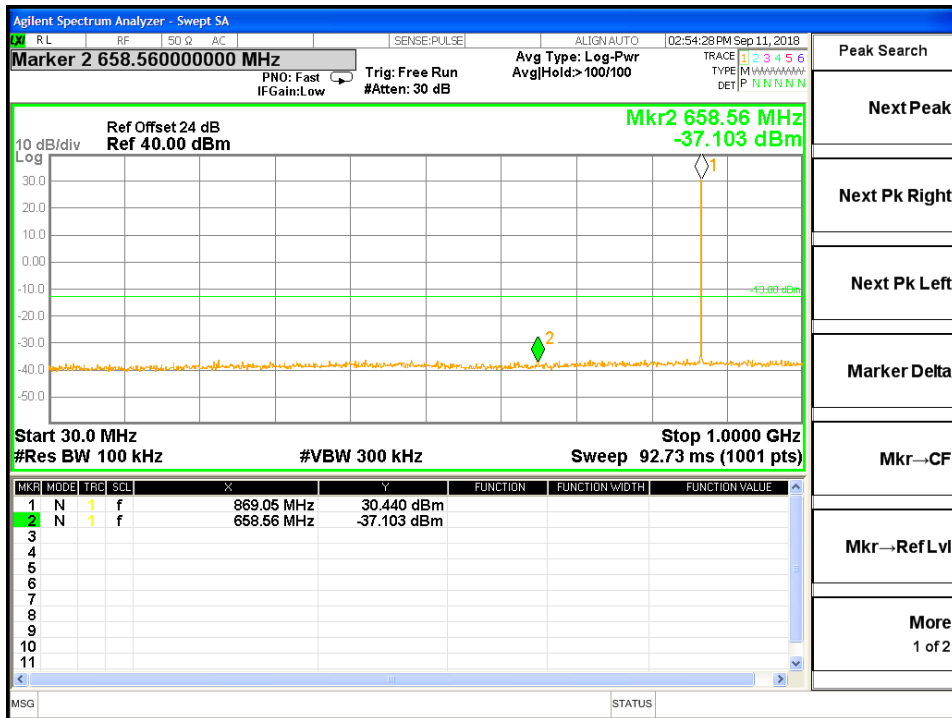
Model 8





CH 3

Model 9





CH 4

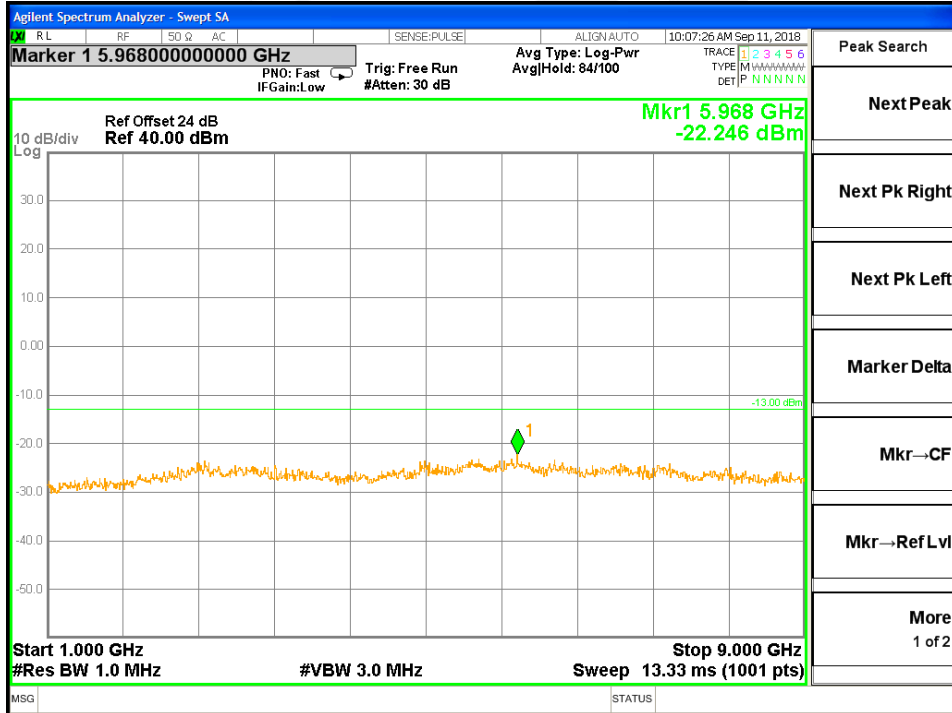
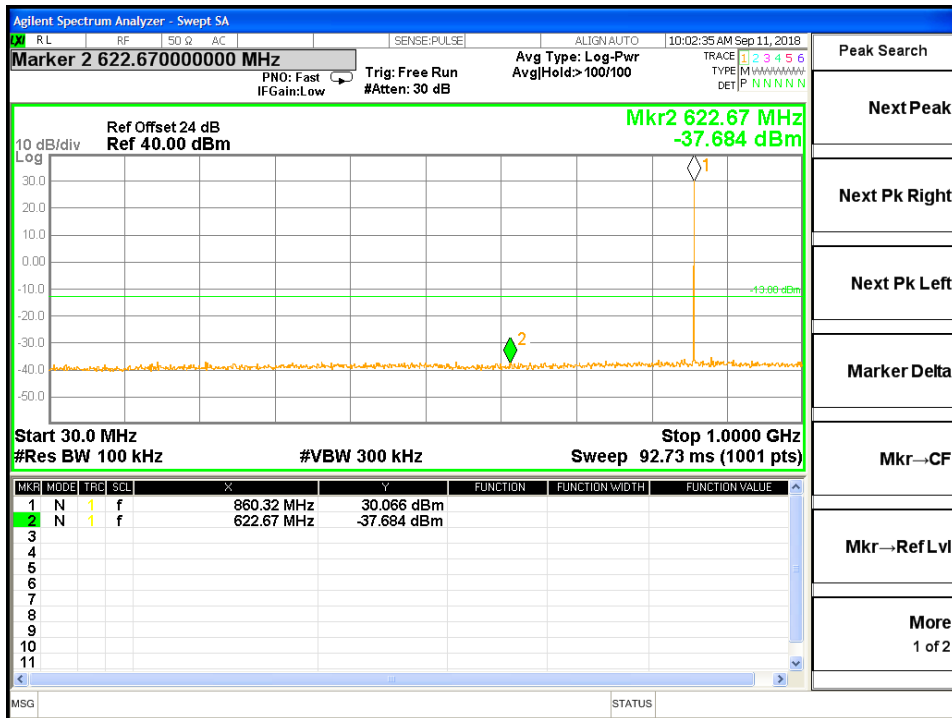
Model 10





CH 5

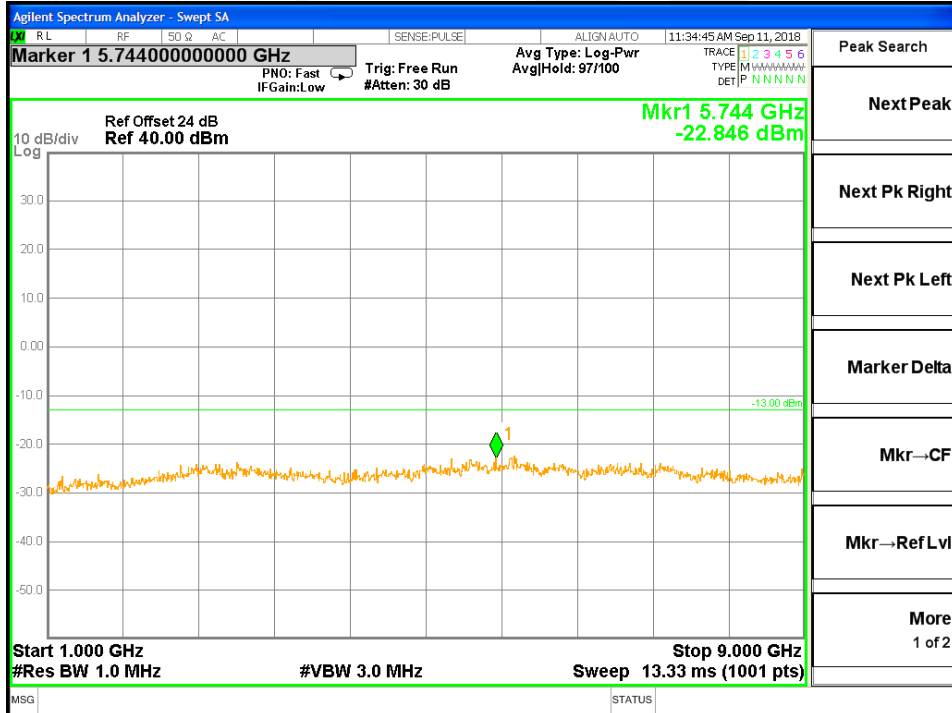
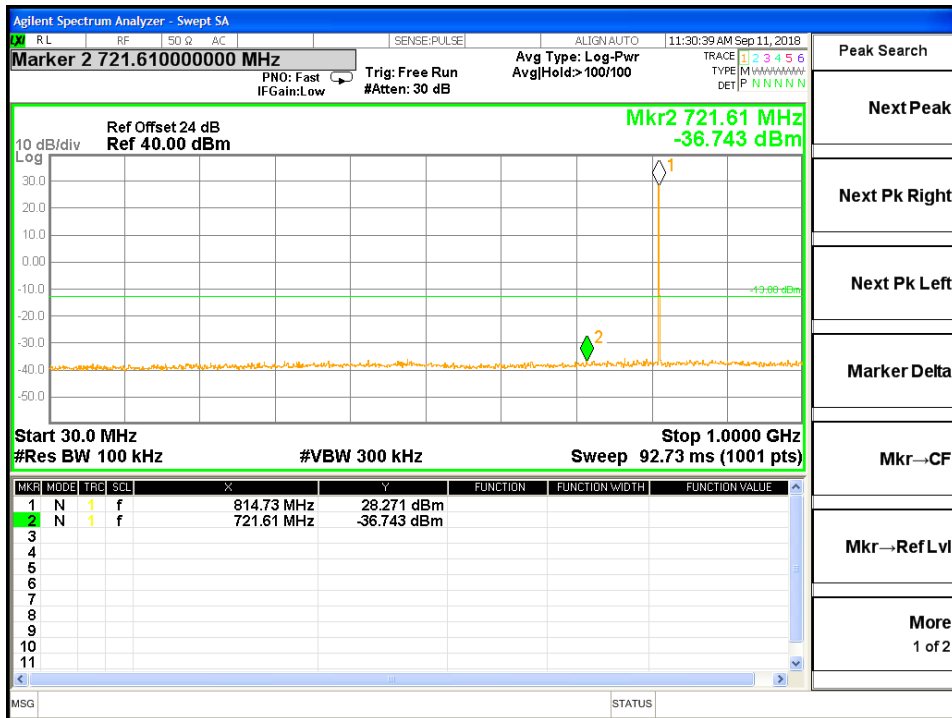
Model 11





CH 6

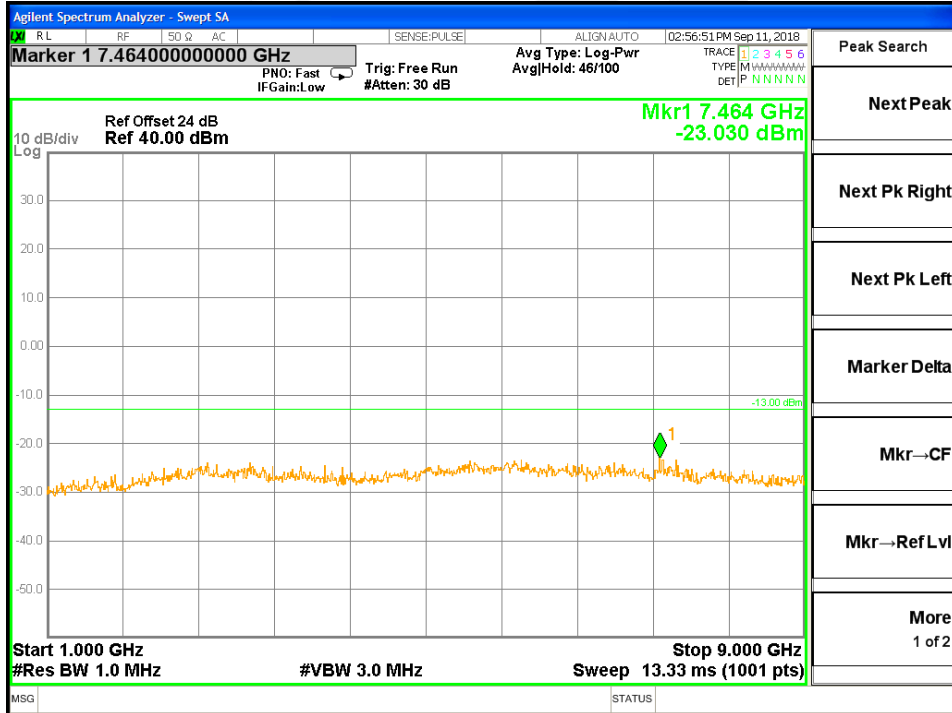
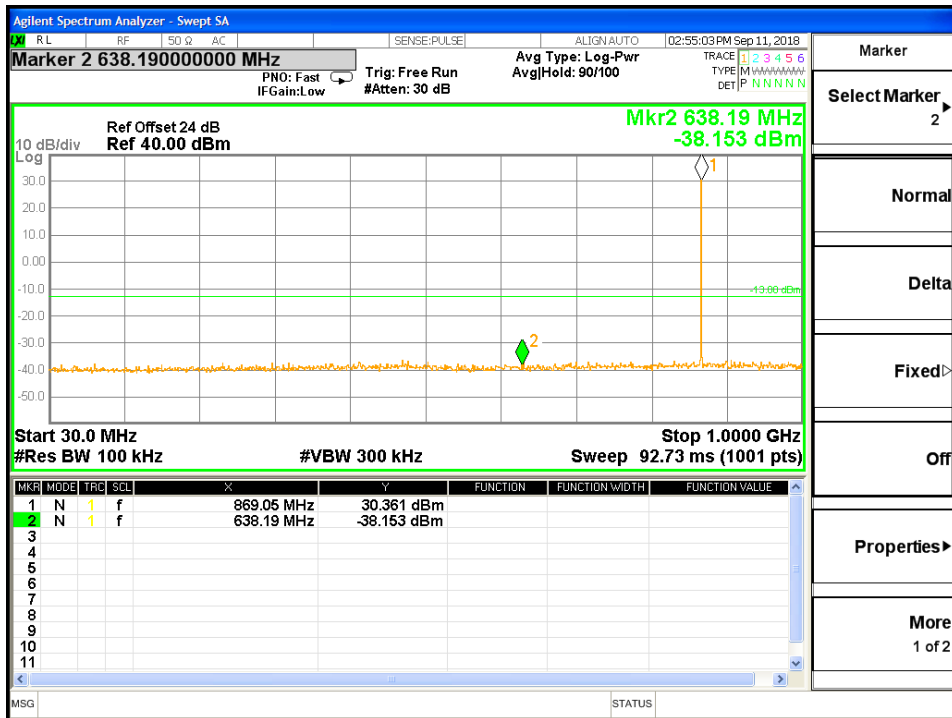
Model 12





CH 3

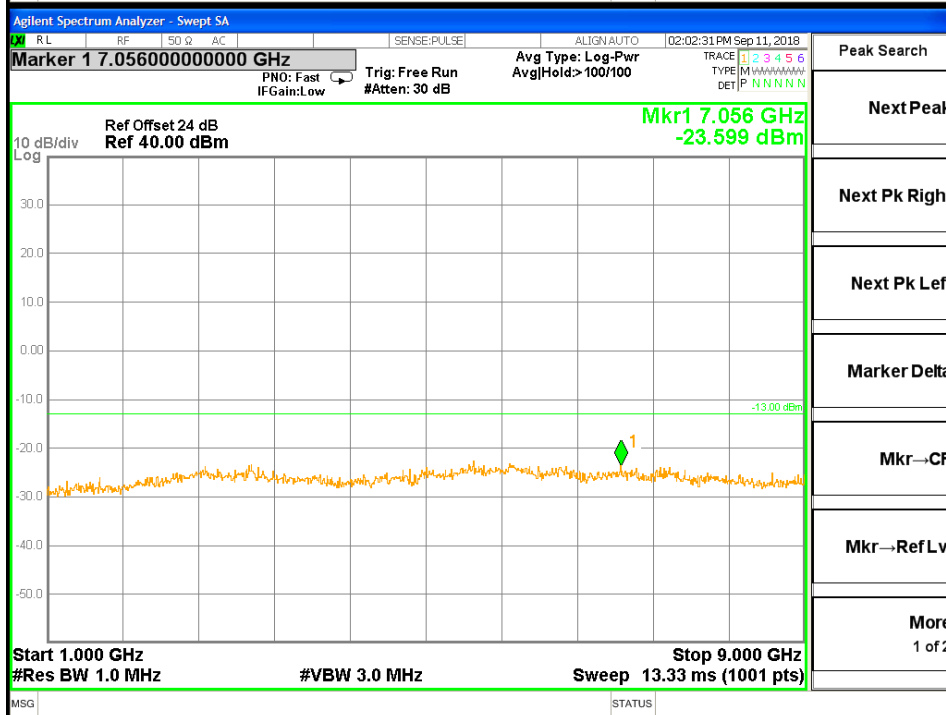
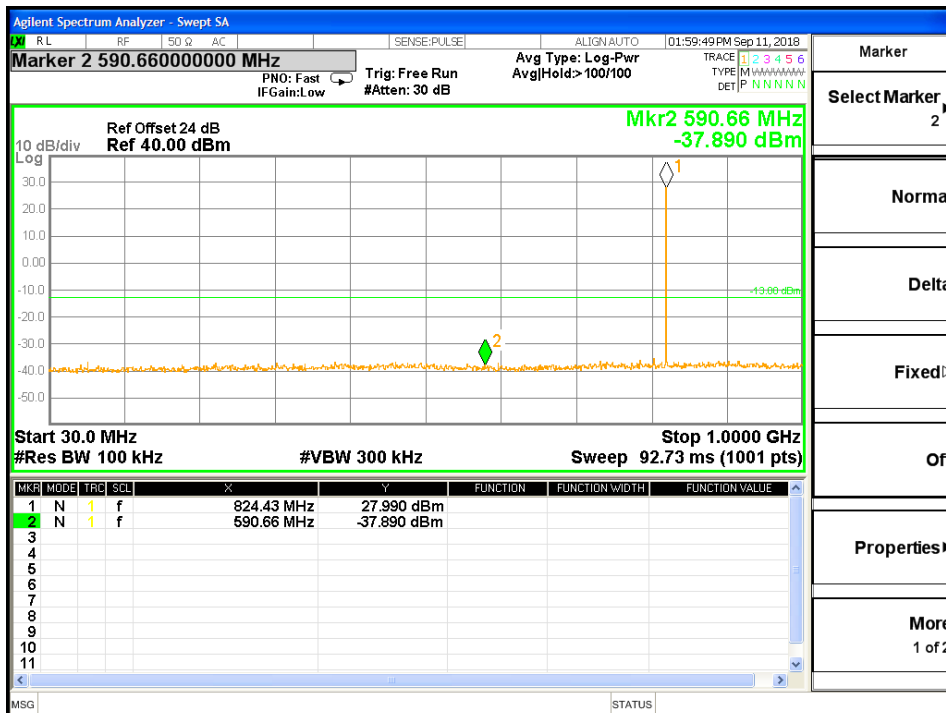
Model 13





CH 4

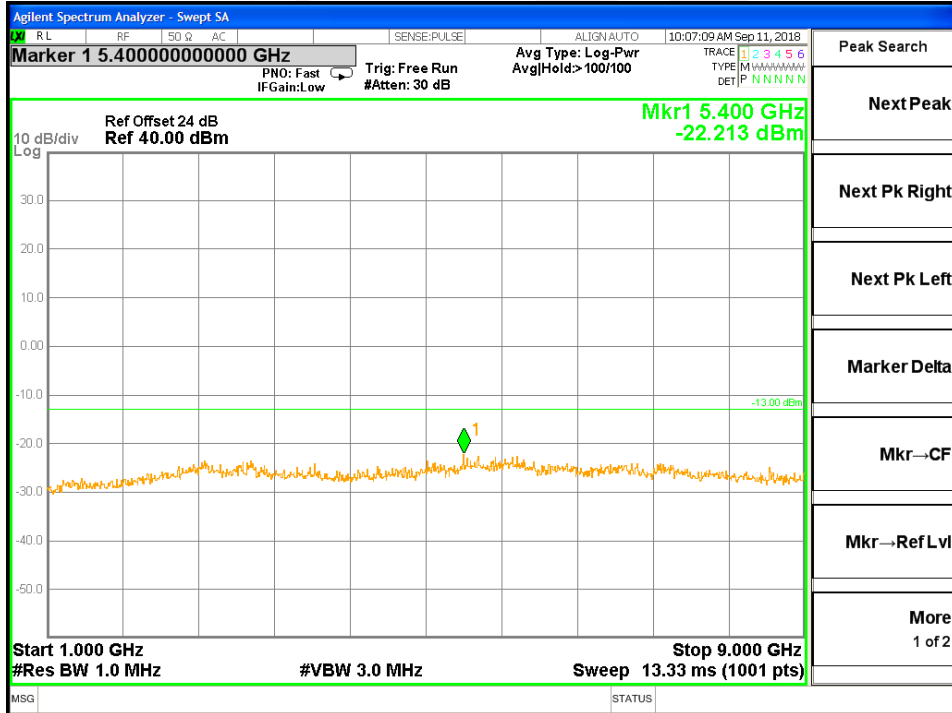
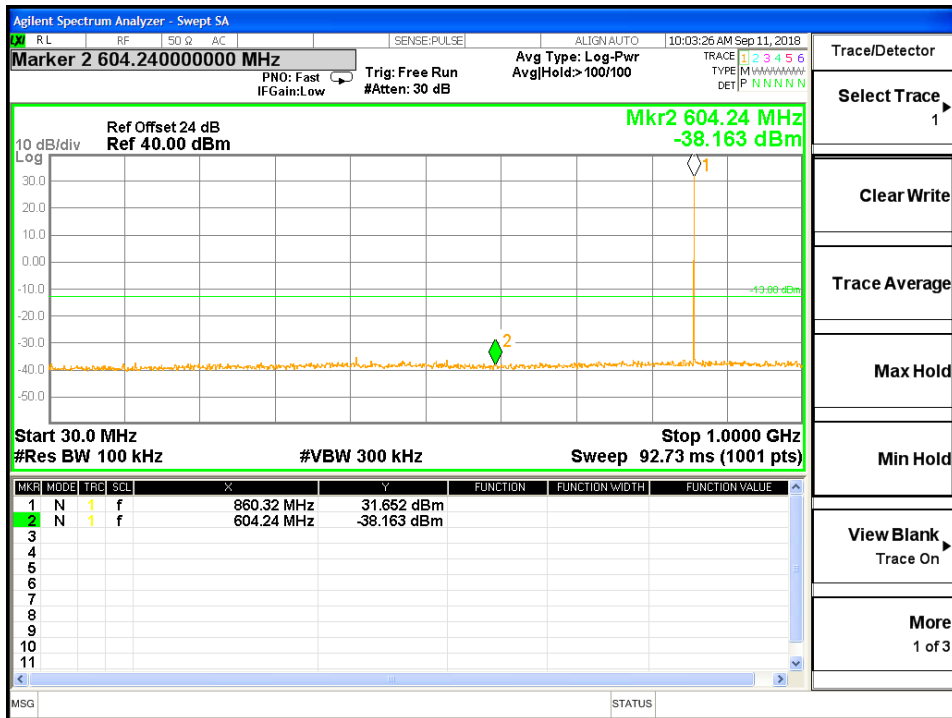
Model 14





CH 5

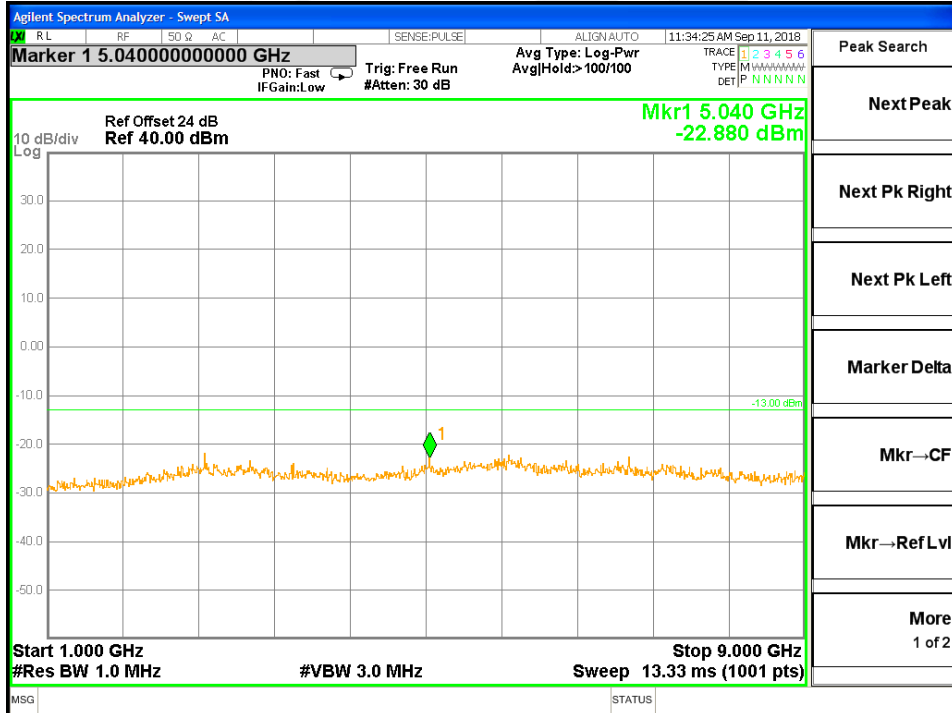
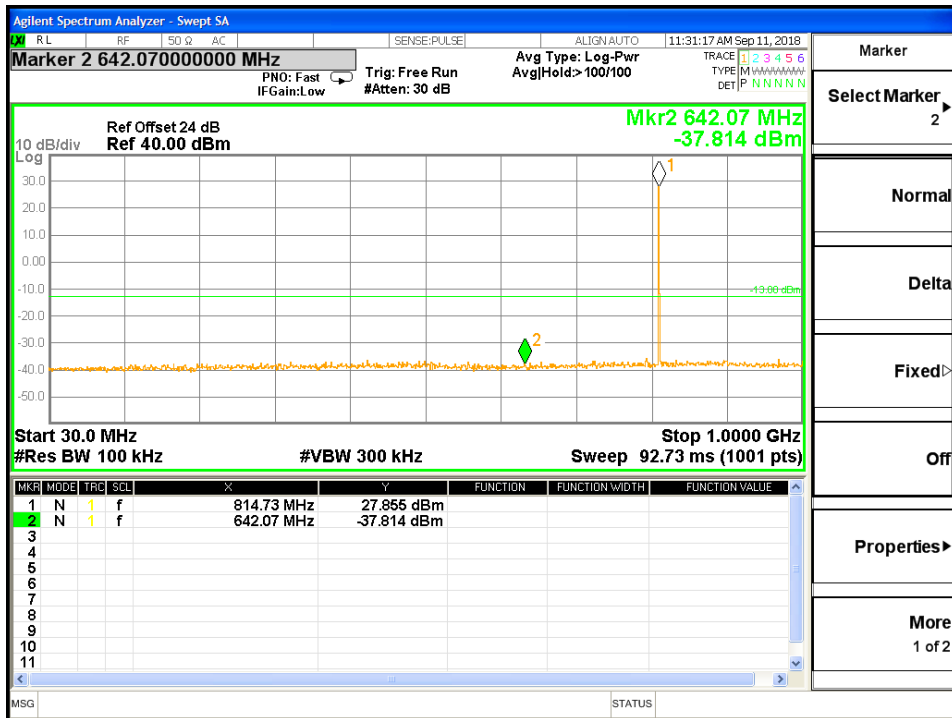
Model 15





CH 6

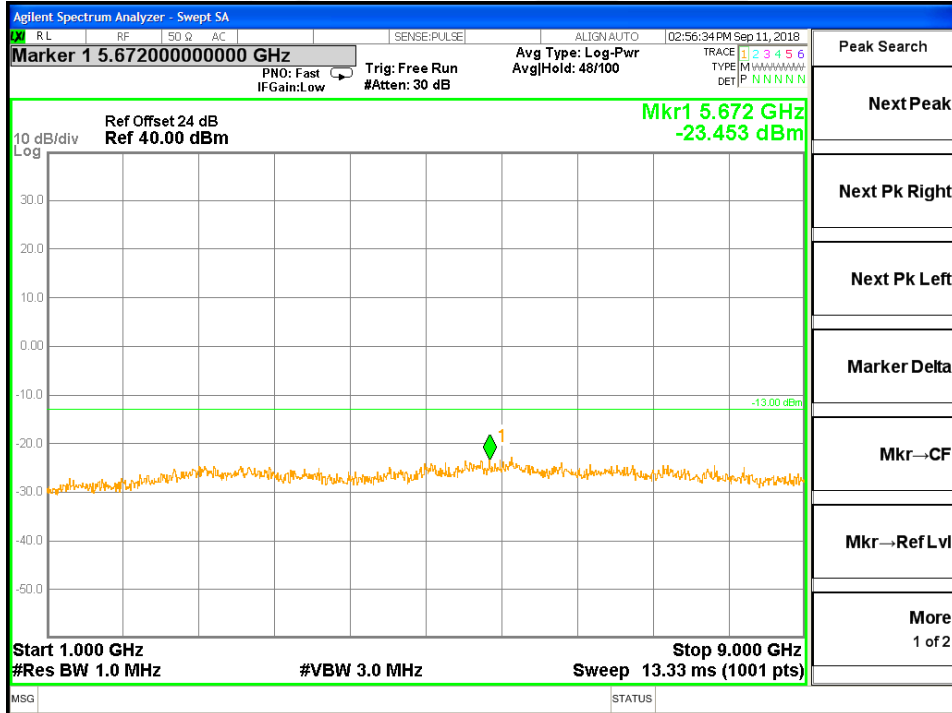
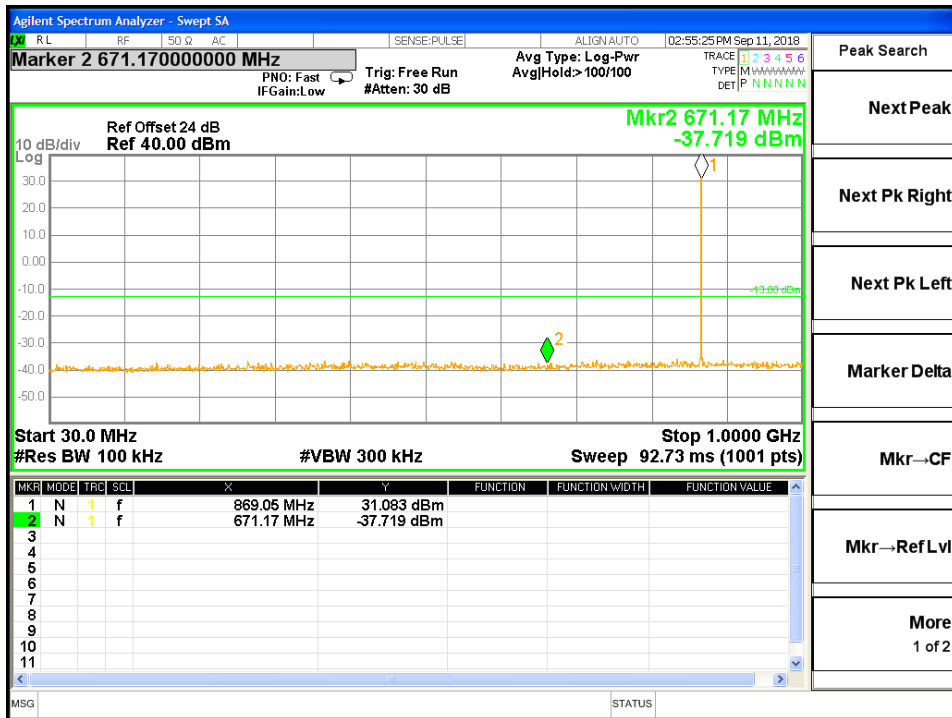
Model 16





CH 3

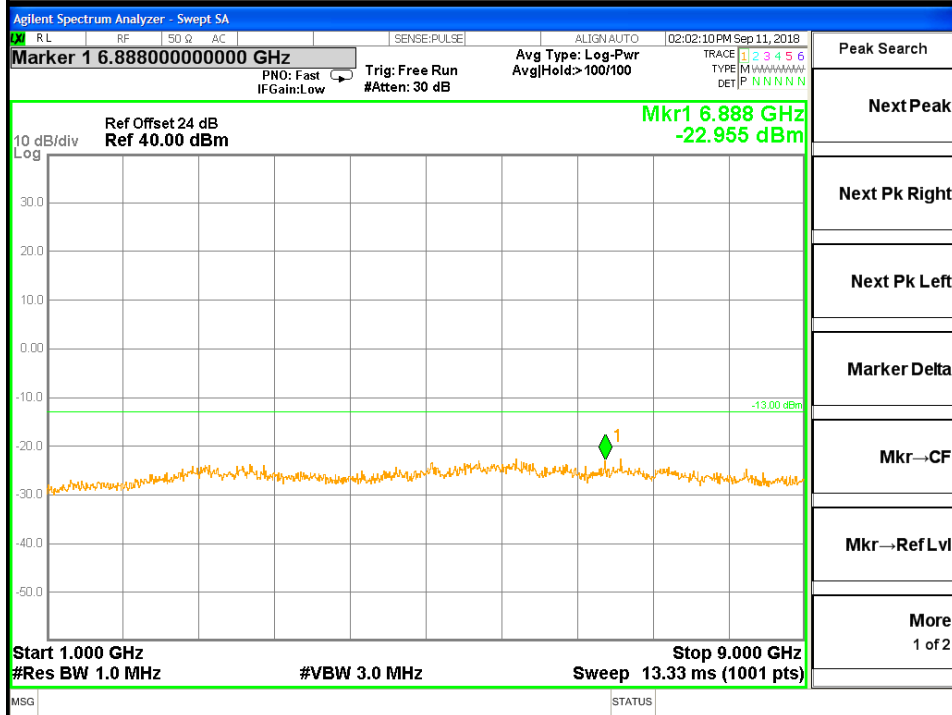
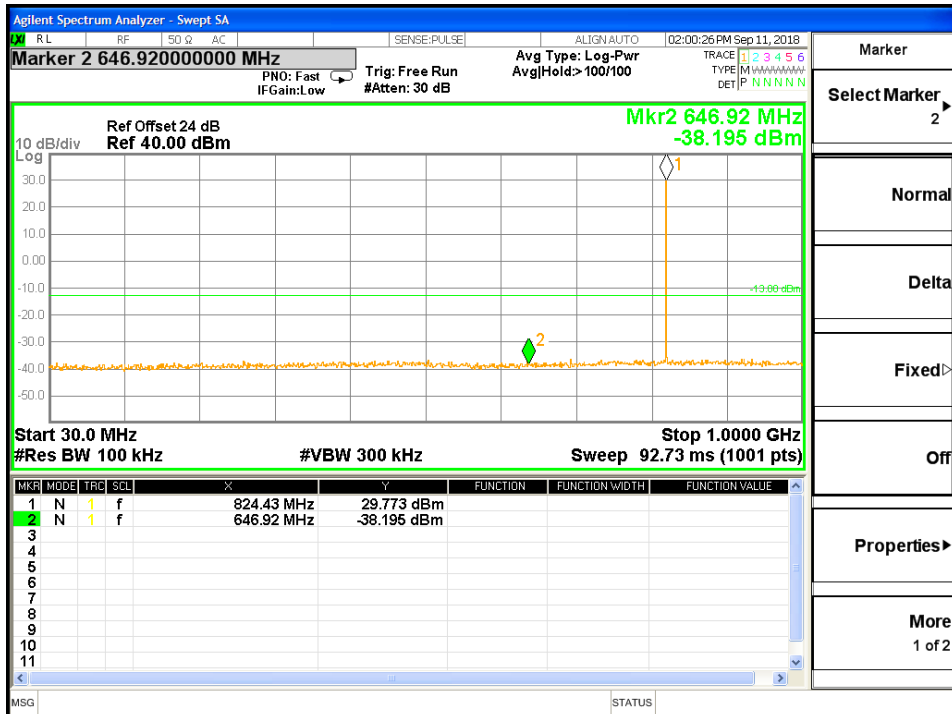
Model 17





CH 4

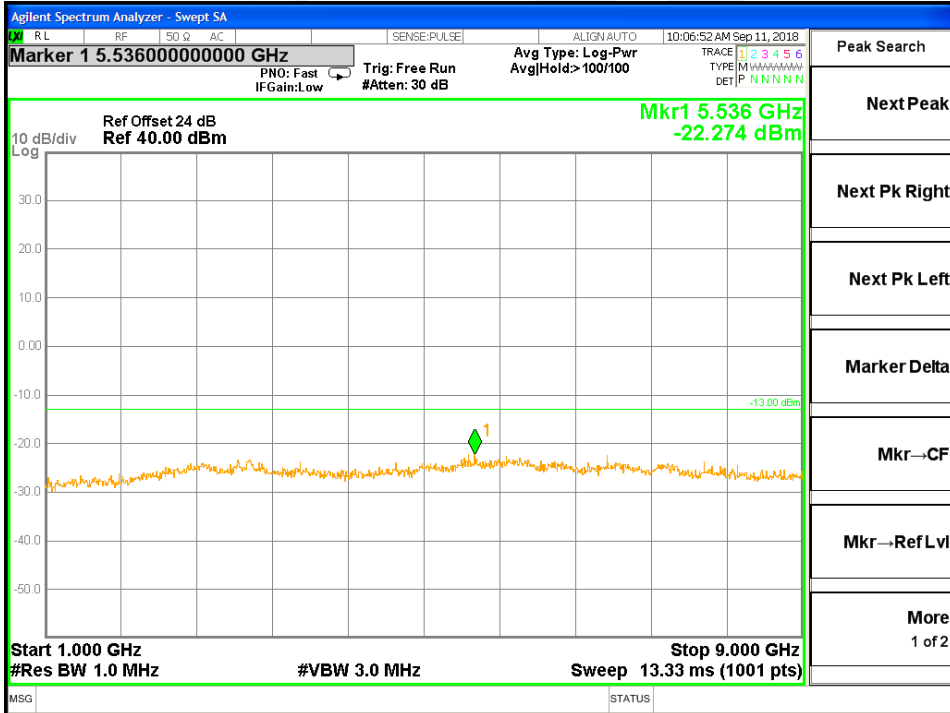
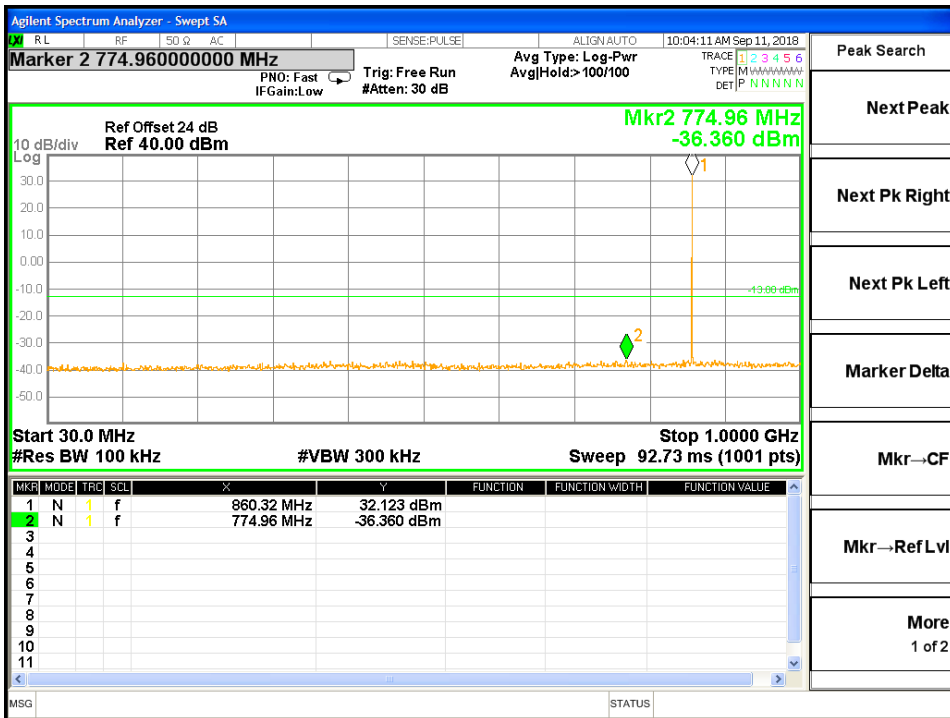
Model 18





CH 5

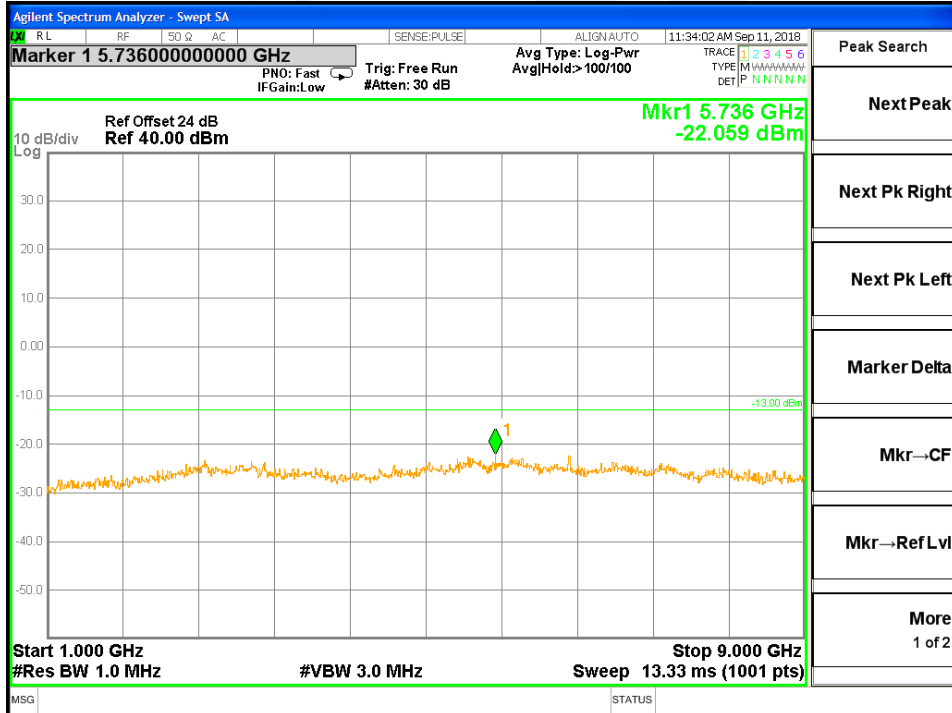
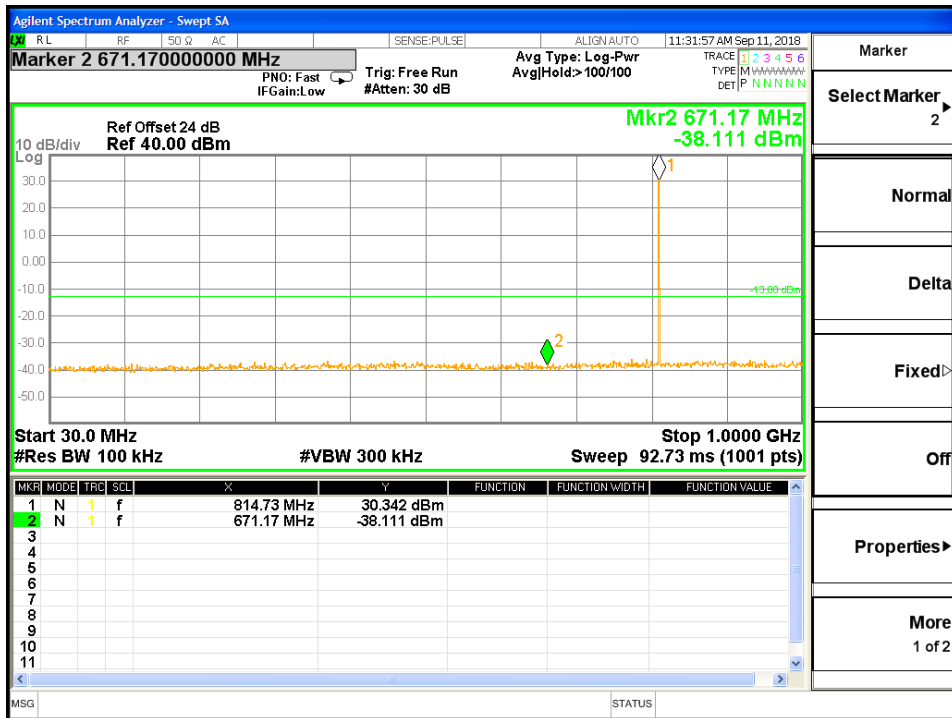
Model 19





CH 6

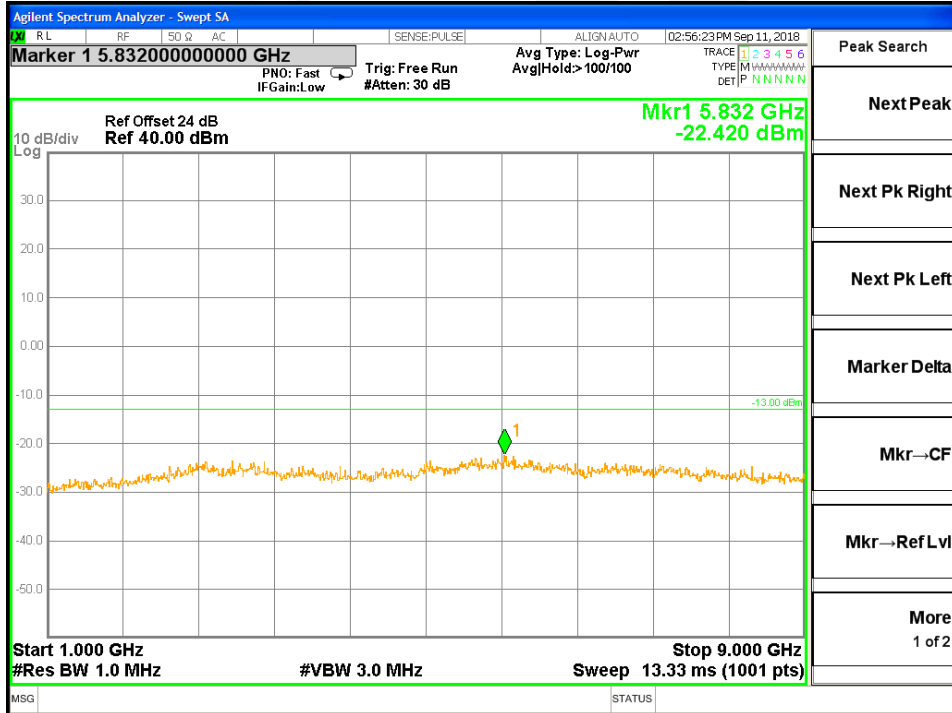
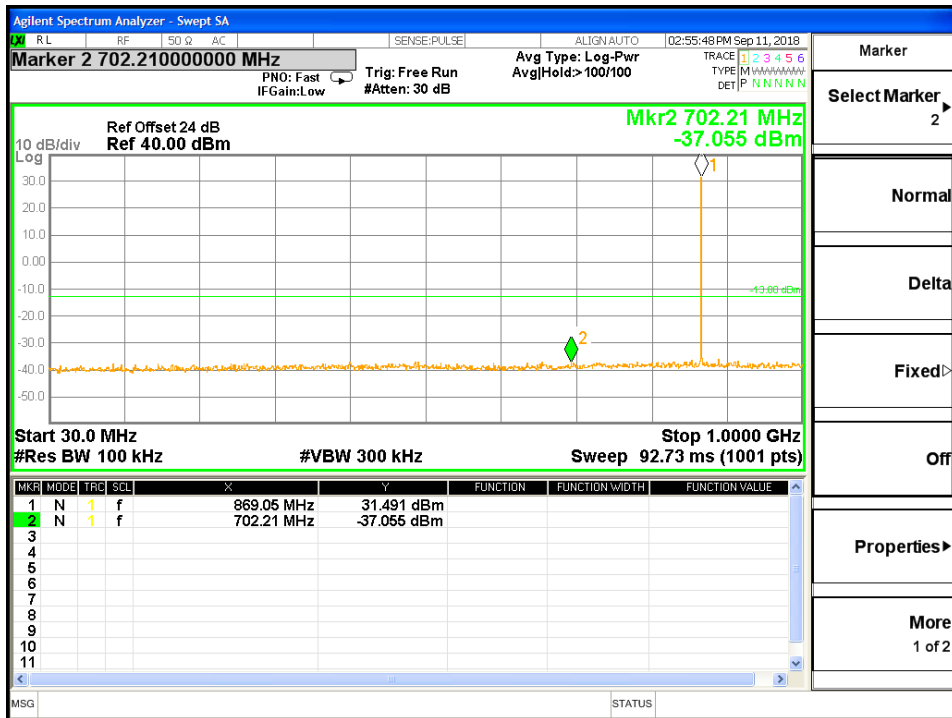
Model 20





CH 3

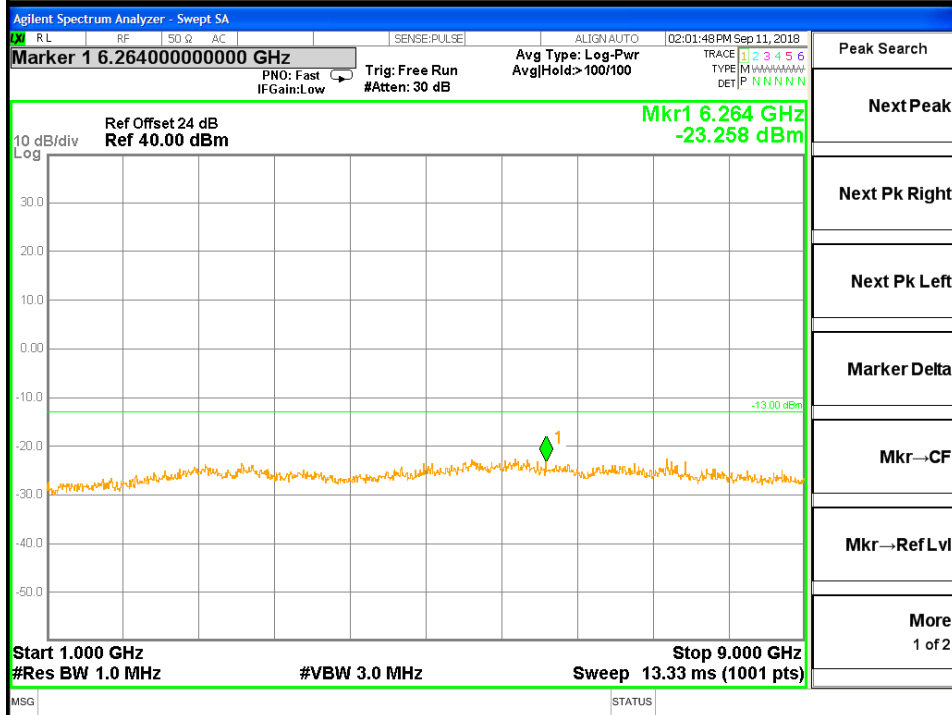
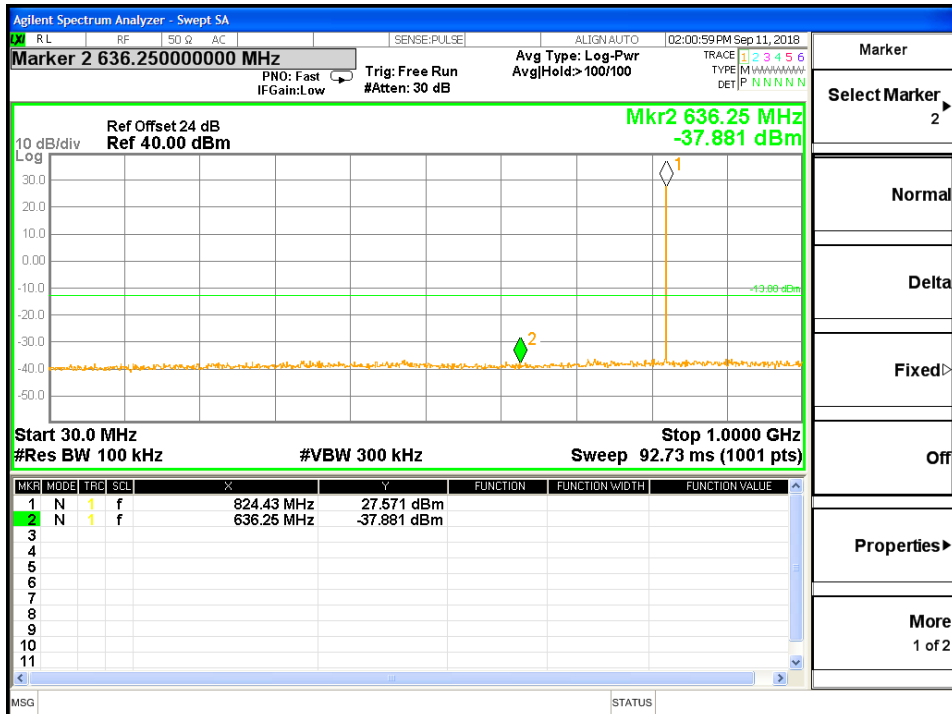
Model 21





CH 4

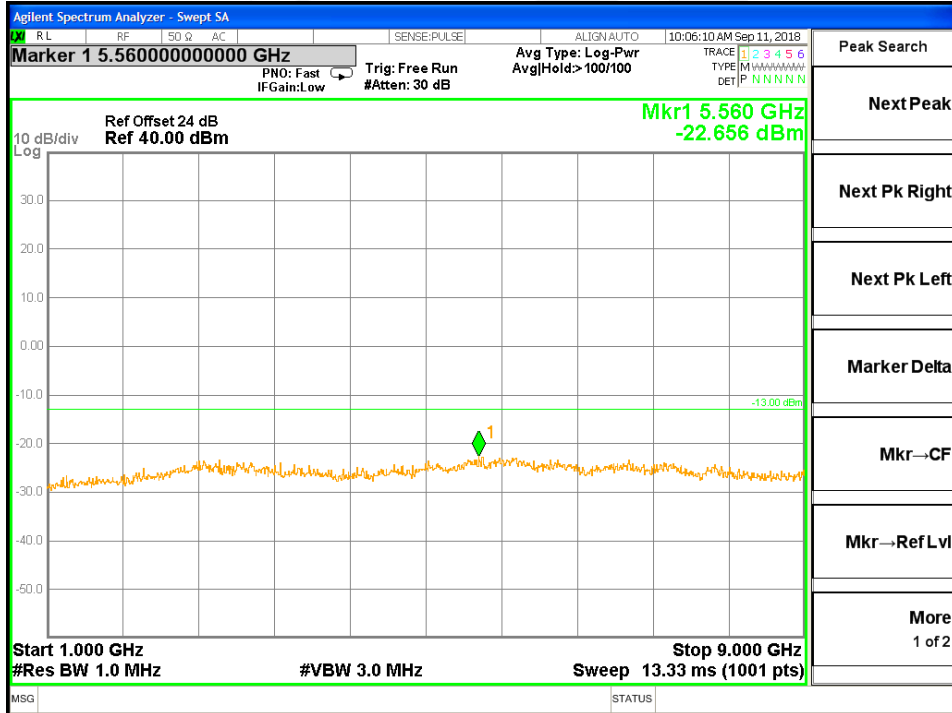
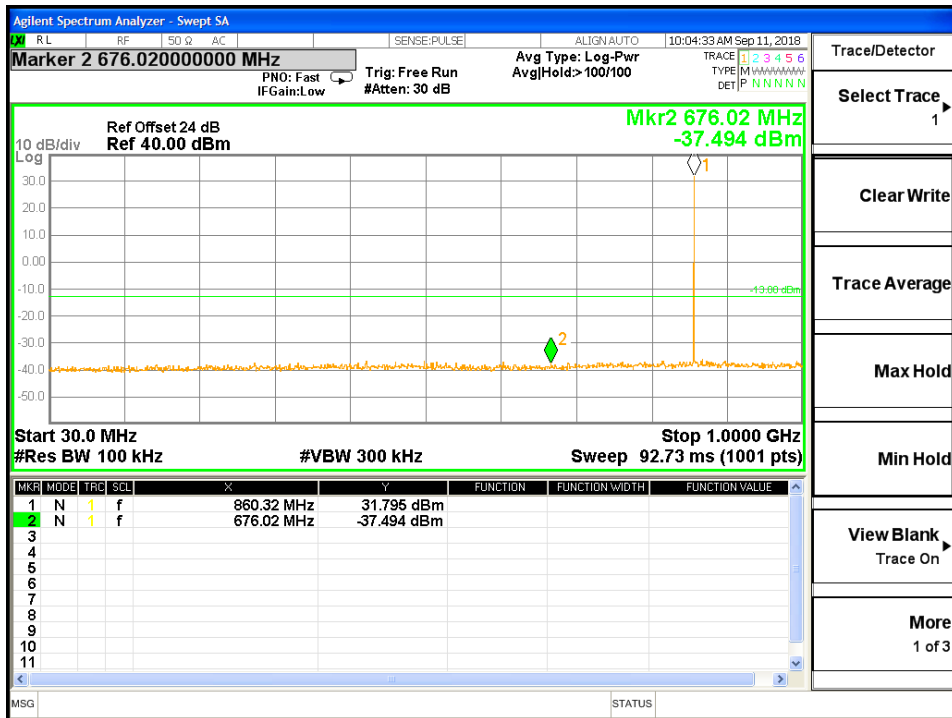
Model 22





CH 5

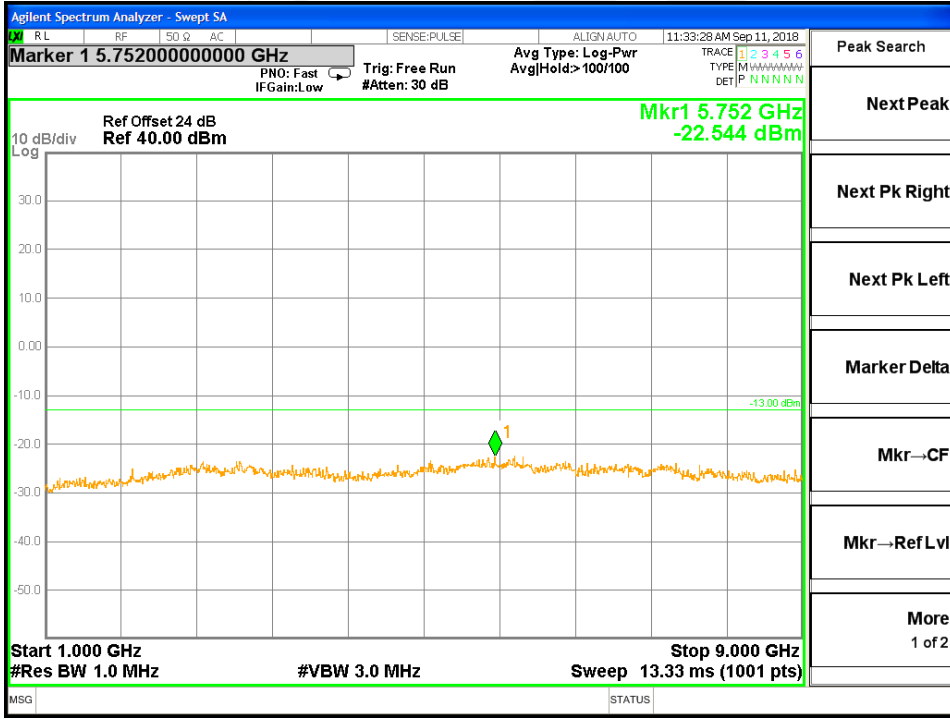
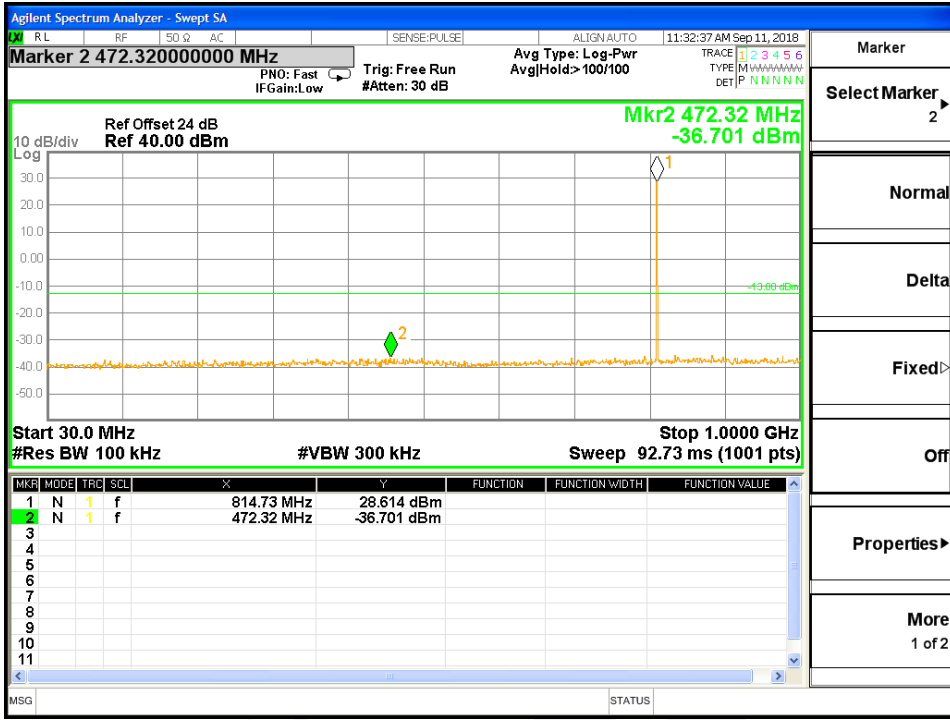
Model 23





CH 6

Model 24



9. FREQUENCY STABILITY

9.1 PROVISIONS APPLICABLE

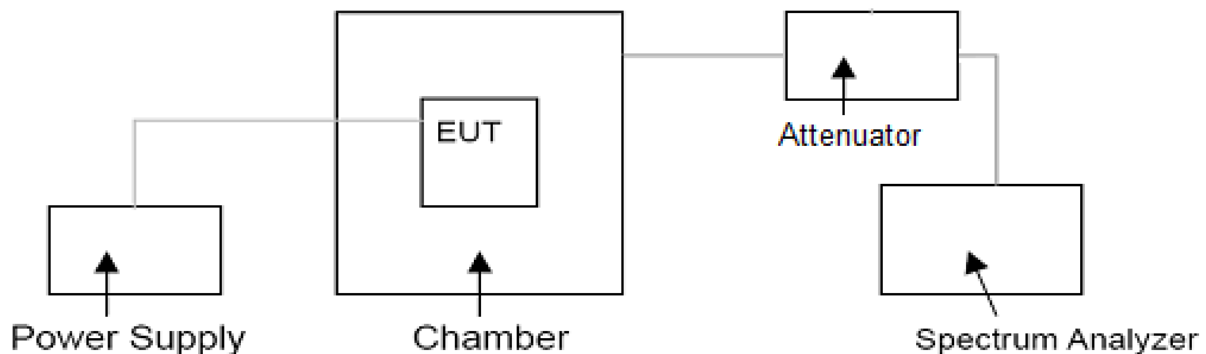
- 1) According to FCC Part 2 Section 2.1055 (a)(1), the frequency stability shall be measured with variation of ambient temperature from -30°C to +70°C centigrade.
- 2) According to FCC Part 2 Section 2.1055 (a) (2), for battery powered equipment, the frequency stability shall be measured with reducing primary supply voltage to the battery operating end point, which is specified by the manufacture.
- 3) Vary primary supply voltage from 85 to 115 percent of the nominal value.
- 4)

Frequency range (MHz)	Fixed and base stations	Mobile stations	
		Over 2 watts output power	2 watts or less output power
Below 25	^{1 2 3} 100	100	200
25-50	20	20	50
72-76	5		50
150-174	^{5 11} 5	⁶ 5	^{4 6} 50
216-220	1.0		1.0
220-222 ¹²	0.1	1.5	1.5
421-512	^{7 11 14} 2.5	⁸ 5	⁸ 5
806-809	¹⁴ 1.0	1.5	1.5
809-824	¹⁴ 1.5	2.5	2.5
851-854	1.0	1.5	1.5
854-869	1.5	2.5	2.5
896-901	¹⁴ 0.1	1.5	1.5
902-928	2.5	2.5	2.5
902-928 ¹³	2.5	2.5	2.5
929-930	1.5		
935-940	0.1	1.5	1.5
1427-1435	⁹ 300	300	300
Above 2450 ¹⁰			

9.2 MEASUREMENT PROCEDURE

- a. The EUT was connected to the spectrum analyzer through sufficient attenuation.
- b. The EUT was set in the climate chamber and connected to an external DC power supply
- c. After temperature stabilization (approx. 20 min for each stage), the frequency for the lower, the middle and the highest frequency range was recorded.
- d. For Frequency stability Vs. Voltage the EUT was connected to a DC power supply and the voltage was adjusted in the required ranges. The result was recorded.

9.3 TEST SETUP BLOCK DIAGRAM





9.4 TEST RESULT

CH 1

Mode 1

Temperature (°C)	Voltage (V)	Nominal Frequency (MHz)	Measured Frequency (MHz)	ppm	Limit	Result
-30	Normal Voltage	851.00625	851.0067	0.529	1.0 ppm	PASS
-20		851.00625	851.0065	0.294		
-10		851.00625	851.0065	0.294		
0		851.00625	851.0067	0.529		
10		851.00625	851.0065	0.294		
20		851.00625	851.0067	0.529		
30		851.00625	851.0063	0.059		
40		851.00625	851.0065	0.294		
50		851.00625	851.0067	0.529		
60		851.00625	851.0065	0.294		
70		851.00625	851.0066	0.411		
25	Maximum Voltage	851.00625	851.0065	0.294		
	BEP	851.00625	851.0067	0.529		

CH 2

Mode 2

Temperature (°C)	Voltage (V)	Nominal Frequency (MHz)	Measured Frequency (MHz)	ppm	Limit	Result
-30	Normal Voltage	806.00625	806.0067	0.558	1.0 ppm	PASS
-20		806.00625	806.0066	0.434		
-10		806.00625	806.0065	0.310		
0		806.00625	806.0065	0.310		
10		806.00625	806.0067	0.558		
20		806.00625	806.0067	0.558		
30		806.00625	806.0063	0.062		
40		806.00625	806.0066	0.434		
50		806.00625	806.0067	0.558		
60		806.00625	806.0065	0.310		
70		806.00625	806.0063	0.062		
25	Maximum Voltage	806.00625	806.0067	0.558		
	BEP	806.00625	806.0065	0.310		



CH 3

Mode 9

Temperature (°C)	Voltage (V)	Nominal Frequency (MHz)	Measured Frequency (MHz)	ppm	Limit	Result
-30	Normal Voltage	868.98750	868.9880	0.575	1.5 ppm	PASS
-20		868.98750	868.9880	0.575		
-10		868.98750	868.9879	0.460		
0		868.98750	868.9881	0.690		
10		868.98750	868.9881	0.690		
20		868.98750	868.9881	0.690		
30		868.98750	868.9881	0.690		
40		868.98750	868.9878	0.345		
50		868.98750	868.9879	0.460		
60		868.98750	868.9875	0.000		
70		868.98750	868.9878	0.345		
25		Maximum Voltage	868.98750	868.9880		
	BEP	868.98750	868.9877	0.230		

CH 4

Mode 10

Temperature (°C)	Voltage (V)	Nominal Frequency (MHz)	Measured Frequency (MHz)	ppm	Limit	Result
-30	Normal Voltage	823.98750	823.9880	0.607	1.5 ppm	PASS
-20		823.98750	823.9878	0.364		
-10		823.98750	823.9881	0.728		
0		823.98750	823.9881	0.728		
10		823.98750	823.9881	0.728		
20		823.98750	823.9879	0.485		
30		823.98750	823.9880	0.607		
40		823.98750	823.9880	0.607		
50		823.98750	823.9881	0.728		
60		823.98750	823.9877	0.243		
70		823.98750	823.9879	0.485		
25		Maximum Voltage	823.98750	823.9880		
	BEP	823.98750	823.9878	0.364		



CH 5

Mode 11

Temperature (°C)	Voltage (V)	Nominal Frequency (MHz)	Measured Frequency (MHz)	ppm	Limit	Result
-30	Normal Voltage	860.00000	860.0005	0.581	1.5 ppm	PASS
-20		860.00000	860.0006	0.698		
-10		860.00000	860.0006	0.698		
0		860.00000	860.0004	0.465		
10		860.00000	860.0006	0.698		
20		860.00000	860.0003	0.349		
30		860.00000	860.0005	0.581		
40		860.00000	860.0002	0.233		
50		860.00000	860.0006	0.698		
60		860.00000	860.0005	0.581		
70		860.00000	860.0006	0.698		
25		Maximum Voltage	860.00000	860.0000		
	BEP	860.00000	860.0002	0.233		

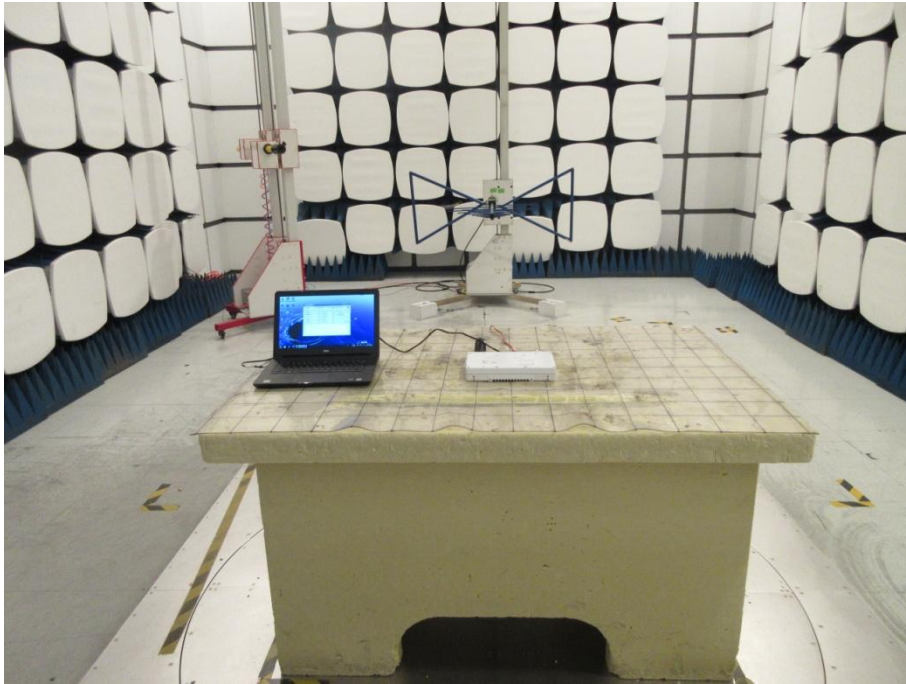
CH 6

Mode 12

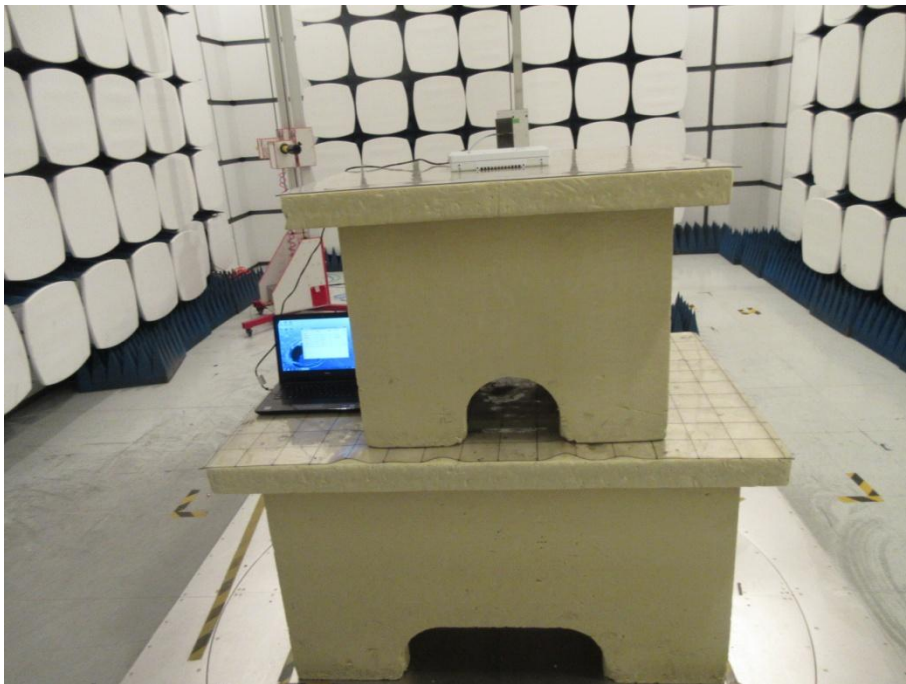
Temperature (°C)	Voltage (V)	Nominal Frequency (MHz)	Measured Frequency (MHz)	ppm	Limit	Result
-30	Normal Voltage	815.00000	815.0005	0.613	1.5 ppm	PASS
-20		815.00000	815.0006	0.736		
-10		815.00000	815.0004	0.491		
0		815.00000	815.0004	0.491		
10		815.00000	815.0006	0.736		
20		815.00000	815.0006	0.736		
30		815.00000	815.0006	0.736		
40		815.00000	815.0005	0.613		
50		815.00000	815.0006	0.736		
60		815.00000	815.0005	0.613		
70		815.00000	815.0002	0.245		
25		Maximum Voltage	815.00000	815.0005		
	BEP	815.00000	815.0005	0.613		

10. PHOTOS OF TEST SETUP

Radiated Measurement Photos 30MHz- 1GHz



Above 1GHz



*****END OF THE REPORT*****